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Custom PC Issue 146

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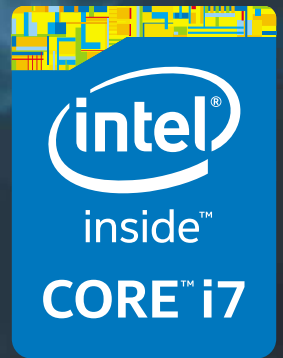
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BEN HARDWIDGE / FROM THE EDITOR

POWER TO THE PEOPLE

As we give Corsair's RM750i a 99 per cent score, Ben Hardwidge thanks the 80 Plus initiative for transforming the PSU business

I can't remember the last time we gave a product a score of 99 per cent, if it's ever even happened. The nature of an itemised scoring system makes getting a perfect balance in every single score hard work, yet this month Corsair has managed it (see p55). But what's significant in this month's PSU Labs isn't so much Corsair's 99 per cent score, but just how close it is to every other PSU's score. I've never seen a **Custom PC** Labs test with so many percentages in the 90s before. The power supply industry has transformed, and while it's fair to say that the likes of Corsair make amazing power supplies, the real reason for all those high scores is 80 Plus.

We've been conducting PC power supply Labs tests for a long time at **Custom PC**. In fact, we were the first magazine to do so, when we first sent James Gorbold over to Tagan's test lab in 2004. At this time, power supplies were marketed on the basis of total wattages, rather than efficiency. Some of the units exploded in the lab, passively cooled PSUs overheated and died, and efficiency results were highly variable.

Then came 80 Plus, which effectively cleared out all the junk – to get a badge, a PSU had to prove its average efficiency was over 80 per cent, while also meeting several other specifications. I was sceptical about the 80 Plus initiative at first. It seemed like the PSU industry was self-regulating itself in a world where very few people had access to the test equipment needed to back up the claims. If Nvidia says a GPU never drops below 60fps in Crysis 3, anyone with the game and that GPU can verify that claim – it's not so easy with PSUs, which require lots of expensive equipment to test properly.

> Some of the units exploded in the lab, and passively cooled PSUs overheated and died

But 80 Plus has completely transformed the power supply business. The differences between the PSUs on test this month are miniscule in comparison to the differences seen in our first PSU tests. We remark on ripple values being higher than others, but even the highest ripple values we've seen this month would have been exceptional results a few years ago.

If you see an 80 Plus logo on a PSU, you can be sure that it will deliver the goods – the variances in quality between power supplies in a specific 80 Plus category are so small that they're not worth considering when buying a PSU. Our PSU tester, David van Dantzig, wrote to me after this Labs test saying that PSUs had become commodities now, as the differences between them in terms of power delivery were so small, and I agree. The important differences between PSUs involve the number and style of cables, the noise levels and new smart features now. The fundamental power supply part has been solved.

This situation is undoubtedly a part of the reason why PSU makers are coming up with other ways to distinguish their PSUs. For example, I have a Corsair RM750i at home, which is great, as its 99 per cent score demonstrates, but I also have a set of individually sleeved modular cables for it, which match the colour of my blue coolant. The whole setup looks great.

And that's what the PSU business has become – pretty wires, quiet operation and a battle of prices. We no longer need to worry about whether a PSU will meet its specification or explode during operation – you just need to look for an 80 Plus logo, and for that the 80 Plus initiative deserves our thanks. **CPC**

Ben Hardwidge is the editor of Custom PC. He likes PCs, heavy metal, real ale and Warhammer 40,000. ✉ editor@custompcmag.org.uk 🐦 @custompcmag

RICHARD SWINBURNE / VIEW FROM TAIWAN

STORAGE REVOLUTION

Intel–Micron's 3D XPoint memory is a true game changer,
says Richard Swinburne

I'm rarely prone to such hyperbole, but Intel and Micron's new 3D XPoint (pronounced 'cross point') memory is about to completely transform data storage as we know it.

The specs are simply incredible. It's 1,000 times faster than the NAND flash memory used in SSDs, it has 1,000 times the endurance of NAND and its durability isn't affected by making it smaller.

It's also 10 times denser than DRAM, yet it will still hold your data when power is removed, so it doesn't need to be constantly refreshed. What's more, it can read and write single bits of data, so there's no need for TRIM and garbage collection tweaks, and there's no performance drop over time. Essentially, it's closer to DRAM in terms of performance, but with SSD-like attributes. NAND has been with us since the 1980s, but 3D XPoint is now perfectly positioned to take over.

If you're an Intel-Micron shareholder you should be grinning from ear to ear, as this announcement seems to have caught the entire storage industry with its pants down. In fact, reports in Various Korean business news sources are reporting that big DRAM/NAND manufacturers such as Samsung and SK Hynix are scrambling to counter the threat of 3D Xpoint, as they hadn't expected such next-gen technologies to mature until around 2019.

At the recent Flash Memory Summit there were some reciprocal announcements regarding competing next-gen storage technologies, such as Sony/Viking's ReRAM (resistive RAM) and HGST's PCM (phase change memory). However, these announcements merely involved tech demos made with tiny ~1Gb (128MB) dies, whereas Intel has committed to actual products made on full-sized 128Gb (16GB) dies in 2016.

> Essentially, it's closer to DRAM in terms of performance, but with SSD-like attributes

Understandably (albeit frustratingly for us), Intel-Micron is keeping mum on the deeper technical details in order to keep its competitive advantage for as long as possible. It has yet to state precisely what products will feature 3D XPoint, but it has confirmed that all launch products will be exclusively made by Intel and Micron and that it won't be working with anyone else initially.

Given current product strategies it's likely that the Intel-branded products will target enterprise and server products, while the Micron-branded kit will be aimed at consumers and businesses.

At launch, Intel-Micron stated that the cost of 3D XPoint memory will sit somewhere between the current cost of DRAM and NAND, but as the former costs significantly more than the latter, that's likely to result in a cost of at least £2.50 per gigabyte by my calculations. That's ten times the price of the current best-value consumer SSDs, and since we don't need ten times as much DRAM in our PCs, it's not likely to replace DDR3/4 either. So where does 3D XPoint fit?

The big gains in data density and durability will mean the first pure 3D XPoint products will target high-end enterprises willing to splash out for this immediate performance boost. To some companies, this extra performance will pay for itself via increased productivity.

For us consumers, though, it could still make it into an upcoming future Micron SSD. Shoehorn a few pieces of 3DX Point memory next to much cheaper TLC NAND in a premium drive, and it will have some ultra-fast caching space. It could potentially even remove the need for a DRAM chip inside the SSD, thereby providing a cost saving, as well as extra speed, less performance degradation and longer life. **CPC**

Richard has worked in tech for over a decade, as a UK journalist, on Asus' ROG team and now as an industry analyst based in Taiwan @Bindibadgi

Letters

Please send us your feedback and correspondence to
letters@custompcmag.org.uk

Love for Windows Media Center

I'm with you about Windows Media Center. I've used it to record all the TV we've watched for around the past five years, and we then use an Xbox 360 to play back the content from my desktop PC onto our rather ancient TV. The system works brilliantly and I love the way that Series Record works – if you have three programmes you want to record at the same time, it works out which one it can record later and does so. It also records series when a new season comes along, so last week I forgot to record The Great British Bake Off, which we got into last year, but WMC didn't forget to record it for me. Brilliant!

I know Microsoft hasn't updated WMC since about 2009, but so what? It works brilliantly and does everything I want from a PVR and much more. I didn't even mind (too much) having to pay for WMC when I upgraded from Windows 7 to Windows 8.

I'm now in the position where I'm going to either never upgrade my desktop PC from Windows 8.1 to Windows 10 (which I do rather like), or I'm going to have to build a separate Windows 8.1 media PC to record my TV (I might even install two dual TV tuner cards). I could then put a whole bunch of hard drives into such a PC, and use some of this storage space as a great backup server for the home network.

I hope Microsoft reconsiders – it doesn't have to continue to develop WMC – it just needs to let us purchase it for Windows 10. The real problem with WMC was that too few people discovered its brilliant TV recording abilities. Perhaps we should launch a preservation society!

RICHARD CURTIS
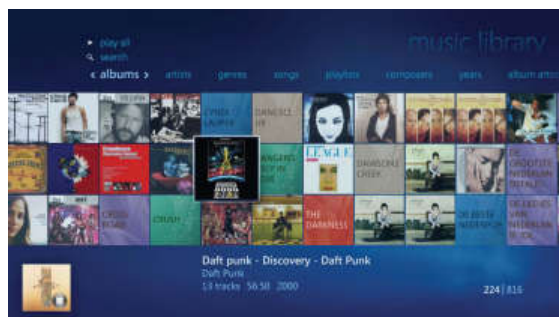
Windows Media Center is no longer an option in Windows 10

Simon Dowse's media PC in his lounge

Ben, Ben, Ben. You, my friend, are not alone! I too run an AMD APU HTPC hooked up to my TV, and I also find it offers the best all-round solution to my media needs. I can burn, rip, stream, watch and play – all from the comfort of my sofa.

My system runs with Windows 7 and Plex, which is served by my WHS2011 home server. I couldn't be without the HTPC, as it's used for ripping and storing media to the Plex server, and for streaming and gaming. As the kids have a tendency to scratch discs, I don't want them going near my physical media collection, but I want them to enjoy the content, and I very much enjoy our movie nights, as I can play the movies through our projector.

Running this system is like combining Netflix, Amazon and Spotify, but with a personal twist. Maybe these aren't the 'last gasp' days, but the dawn of something more customisable and flexible – think Roku running Linux with customisable hardware. Don't confine yourself, open all the doors!

MATTHEW WARD

Yes, we still use a PC in the lounge. It's in a SilverStone Milo case with an MSI motherboard, an Intel Core i3-2105 at 3.1GHz, 4 GB of RAM, an Asus Xonar sound card and a Black Gold TV card. It runs Windows 7 and apparently Microsoft will be supporting that OS up to 2020, so we'll just stick with that for now.

We mainly use the PC for recording and watching TV (Freeview) and music. In addition, my wife uses it for email, word processing, accounts and Photoshop. As Ben says in his editorial, it's this dual use that's unique to a Windows media PC. We even have a separate monitor connected to it in another room so it can be used as a standard desktop. We'll have to see what happens in five years!

SIMON DOWSE

Ben: These letters represent just a fraction of the positive correspondence we received this month about Windows Media Center – it's clearly very popular with plenty of enthusiasts. I hope Microsoft takes note!

● ● ●

Thunderbolt isn't just for Macs

Your review of the Asus Z170 Deluxe highlights **CPC**'s bizarre disinterest in Thunderbolt. If you read up on Thunderbolt 3 (over USB type-C connector), it's looking very exciting for many uses, including finally getting proper support for external graphics cards, 10Gb Ethernet, LS-Pcon and so on. Yet in Issue 145, p23, you off-handedly remark that 'USB type-C connectors double up as 40Gb/sec Thunderbolt 3 ports'.

Unless I'm extremely mistaken, the ASMedia controller used has no Thunderbolt capability at all, and is solely for USB 3.1 – Asus would need

to incorporate Intel's Alpine Ridge system to achieve Thunderbolt 3 capabilities, and the situation is visually clear from the lack of a Thunderbolt symbol next to the USB type-C port.

The only way you could get Thunderbolt on this motherboard is by purchasing one of the various Asus ThunderboltEX add-on cards, which slots into the on-board TB header; even then you wouldn't get Thunderbolt 3, as these cards only offer up to version 2 over a mini-DisplayPort style connector, not USB-C. It's time that **Custom PC** got a grip on that fact that Thunderbolt isn't just for Mac fans or ultra-enterprise nonsense.

When Thunderbolt 3 over USB-C does actually hit motherboards, it could easily be adopted much more widely, due to the shift from using mini-DisplayPort to USB-C, as well as the greater interest of third parties and the less expensive cables required – cheaper, regular passive USB-C cables can be used, but also more expensive active cables for those who want the full 40Gb/sec.

CHRIS JONES

Orestis: Thanks for bringing this to our attention Chris. What we said was technically correct, as type-C USB connectors are the very same ones used by 40Gb/sec Thunderbolt 3, but, as you say, for a motherboard to support the standard, it has to incorporate Intel's Alpine Ridge Thunderbolt controller. To clarify, the Z170 Deluxe doesn't have an integrated Alpine Ridge controller and therefore doesn't support Thunderbolt 3. Future Skylake motherboards are certain to

Twitter highlights

Stuz719 Errr...since when were bats rodents, exactly, @CustomPCMag? Issue 145, page 80
Rick: I was of course referring to that lesser-known superhero, Ratman (Apologies for the error).

Duncan_Lloyd Reading this month's Dream PC 2015 on my hols. Wow, what a line-up! How come you only scored 24/25 for 'Fastest PC ever'?
Ben: I know, we were very sad to see the Dream PCs leave the lab – amazing machines! The Overclockers 8Pack Supernova got 24/25 because there were a couple of tests where it wasn't the quickest of the group, even if it was the fastest overall – it still got the highest speed score.

varkanoid Does anyone look at the Readers' Drives each month and first think 'I bet that's a bugger to dust!'
Ben: Ha, it's crossed my mind before, certainly!

Lincoln_Ess Is there any way to get hold of past issues? Recent subscriber wanting to check out prev reviews.
Ben: Sadly we don't have a way to access

paper copies of previous issues, but you can buy some of our back issues in digital format. The Zinio website at http://gb.zinio.com has all the issues from October 2010 onwards.

NVIDIA_UK A huge congrats to @ScanComputers for winning the 2015 Custom PC #DreamPC award! DAMN this thing looks good!

BernardMagny Great article from J. Gorbold this month. Q: Are the capabilities of the M.2 slot on X99 chipset similar to the new Z170?
Ben: Yes, M.2 can work similarly on X99, with an M.2 slot either taking two PCI-E 2 lanes from the chipset, or four PCI-E 3 lanes from the CPU. We saw some great speed from PCI-E M.2 drives in our Dream PC labs, which were all based on X99.

linaelvira Bought @CustomPCMag on Zinio. It suggested I also buy a men's mag?? Boo. I can like lip gloss AND computer hardware, who says I can't :(
Ben: Glad to have you on board! I can't guarantee we'll cover any lip gloss, but there will be definitely be lots of computer hardware.

The USB type–C port on the Asus Z170 Deluxe has the same physical connector as Thunderbolt 3 devices, but that doesn't mean it supports Thunderbolt 3

support it, but initially we expect this feature to be only found on top-end boards, carrying a high premium.

We're enthusiastic about Thunderbolt though. It offers truly excellent performance and the new standard remains one step ahead of even the 10Gb/sec offered by USB 3.1. It carries both video and PCI-E data, and as you say, makes external graphics cards a possibility, although this idea hasn't taken off yet.

Unfortunately, despite its technical superiority, support for Thunderbolt is dwarfed by that for USB which is clearly the de facto standard for external storage. Cost is the major issue, with

even the cabling being expensive, and again, you're right to point out that the ability to use cheaper USB cables could help its adoption.

But the cost of implementing Alpine Ridge on motherboards still presents a chicken-and-egg problem for Thunderbolt. Without its inclusion on more PCs, storage firms will generally choose to sell products that support USB instead of Thunderbolt, and without many storage devices to support it, motherboard manufacturers will probably feel they can cut costs by leaving it out entirely. **CPC**

WHEN'S THE NEXT MAG COMING OUT?
Issue 147 of **Custom PC** will be on sale on Thursday, 15 October, with subscribers receiving it a few days beforehand.

OCT 15

TRACY KING / SCEPTICAL ANALYSIS

REAL OR NO REAL

Noel Edmonds reckons the 'wrong sort of electromagnetism' is more serious than Ebola, but we need to hold these claims to account, argues Tracy King

A favourite quote, said by Richard Dawkins about some aspects of pseudoscience, is 'the best thing about an opinion like that is we can safely ignore it'. The quote works because the person spouting the uninformed opinion is invariably a random Tweeter with three followers and a theory about how jet fuel can't melt steel beams.

But when the person espousing a silly idea has the three Ps – power, privilege and platform – we can't safely ignore it, as the silly idea will invariably spread and potentially do harm. This column is about holding those with three Ps (usually the media) to account, and examining the veracity of their claims.

Noel Edmonds, for example, has the three Ps and sometimes uses them to promote and profligate piffle. His original piffle is in the form of a particularly silly belief in 'cosmic ordering'. The idea is that you wish super-hard for something – for example, a new bike – write it down on a bit of paper, and hope the universe gives it to you. It's a little like Argos, but where Argos insists on money for the bike, cosmic ordering relies merely on wanting something badly enough.

That's all very well and good until you think of the implications for those whom life has dealt a terrible hand. Kid with leukaemia? Guess you didn't wish hard enough, buddy. Live in a war zone? Psh, you should have written down 'don't bomb my house'. That those who get riches and success invariably start with the three Ps is somehow irrelevant, and instead it's all down to the amazing hard work they put in daydreaming.

But now, while promoting a new radio show, Edmonds has made a song and dance (no Mr Blobby, not you) about

> There's simply no evidence to support the scaremongering about Wi-Fi giving people migraines or cancer

the 'wrong sort of electro-magnetism', which is, according to Edmonds, 'the biggest problem we have. Not Ebola, not AIDS, it's electro-smog'.

However, there's simply no evidence to support the scaremongering about Wi-Fi giving people migraines or cancer, and that's the only substance to these claims – scaremongering based on fear of what we can't see or hear, which is as old as humans and possibly older even than Noel Edmonds (who says death doesn't exist, so I don't think I'm making a cheap age joke at his expense). Wi-Fi is safe, mobile phones are safe, satellites are safe, microwaves are safe.

In fact, there's 30 years' worth of data, and over 25,000 scientific articles about it, to prove Edmonds wrong. As the World Health Organisation puts it, 'scientific knowledge in this area is now more extensive than for most chemicals.'

The mistaken people who believe they're affected by electro-sensitivity may have real symptoms, but the cause isn't the low-level radiation that keeps the modern world ticking. However, these victims of an imaginary illness are spending money on quack cures and 'insulating' blankets, and in some cases, even committing suicide. It's just not okay for someone with the three Ps, such as Noel Edmonds, to use them so irresponsibly.

A few years ago I appeared on Noel Edmunds' show Celebrity Deal or No Deal as a box opener. If you haven't seen the show, you want to have a low amount in your box to win the highest amount for charity. I wished *really* hard, and lo and behold, my box was the 1p box. Just another two Ps to go and I get my own show. **CPC**

Gamer and science enthusiast Tracy King dissects the evidence and statistics behind popular media stories surrounding tech and gaming @tkingdoll

Incoming

We take a look at the latest newly announced products

AMD unveils mini 4K graphics card

After unveiling the small PCB of the Fury X, it was only a matter of time before AMD took full advantage of its High Bandwidth Memory (HBM) technology and produced a tiny graphics card for mini-ITX rigs. We've seen compact graphics cards for mini-ITX systems before, of course, but none of them has sported the specifications of AMD's new R9 Nano card.

Using AMD's Fiji architecture, its 4GB of HBM memory is positioned on the GPU package in small chips, rather than in large chips on the PCB, so the whole card only measures only 6in across. Plus, unlike the Fury X, it has a cooling fan on the card and doesn't require a liquid-cooling unit. Nevertheless, it still packs 4,096 stream processors, with its core clocked at up to 1GHz, so it should still be able to play plenty of games at 4K. AMD also claims the card only draws 175W from the mains. We're hoping to get a review sample soon, so watch this space.

Asus water-cools laptop

In a bid to counter the thermal problems of cramming high-end PC gear into a laptop chassis, Asus has unveiled a new water-cooled ROG laptop at the IFA show in Berlin. The new ROG GX700 features a 17in 4K IPS screen, an overclockable K-series Skylake CPU and Nvidia's forthcoming GTX 990M GPU. All the water-cooling gear is concealed in a massive unit at the back, which looks a little like a speaker system, but in fact contains a radiator, pump and reservoir.

NZXT enhances S340

We're already fans of NZXT's S340 chassis, which has been our favourite budget ATX case for a good few months now, but NZXT has just taken it a step further with a new special edition flavour of the case. As with the H440 Special Edition, NZXT has brought Razer on board to provide a touch of pizzazz, with a backlit triple-headed Razer snake logo on the front, a tinted window and an eerie green glow emanating from the underside. NZXT has also firmed up the chassis itself, with the S340 Special Edition boasting a 90 per cent steel construction. The NZXT S340 Special Edition is due to be released at the end of September, for £84 inc VAT.

Nvidia releases GeForce GTX 950

Nvidia has finally completed its GTX 900-series, filling the gap at the low end with the new GTX 950. Nvidia says the new GPU aims to make games playable at 1080p, featuring 768 stream processors, a 1,024MHz core clock and a 1,188MHz boost clock. Meanwhile, the 2GB of GDDR5 memory runs at 6600MHz (effective) and is hooked up to a 128-bit wide memory interface. Cards based on the new GPU will also support two-way SLI and Nvidia's G-Sync technology. GeForce GTX 950 cards are available now, starting at £125 inc VAT from **www. scan.co.uk**, and we'll be getting a sample for review shortly.
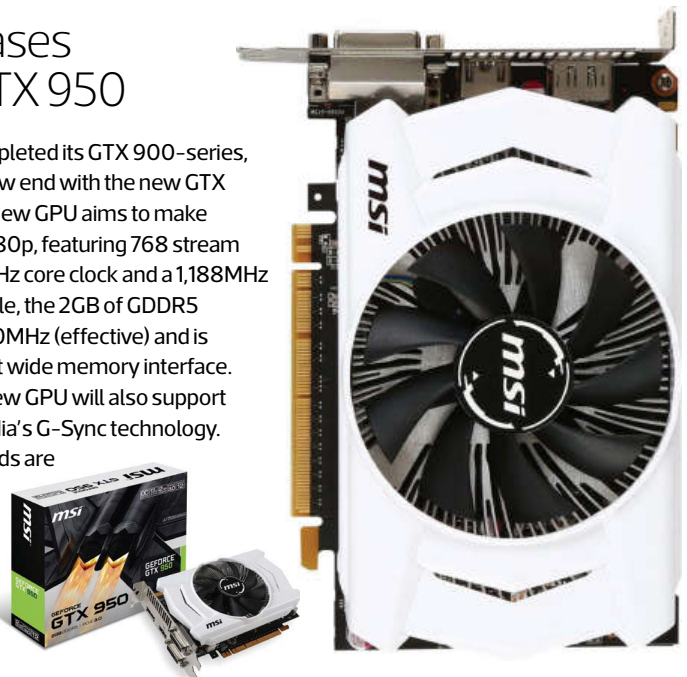
Reviews

Our in-depth analysis of the latest PC hardware

Reviewed this month

OPERATING SYSTEM

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SUPPLIER www.scan.co.uk

We haven't enjoyed your behaviour, Windows. You've spoiled what could have been quite a lovely past few years for desktop PC users. Now go home and think about what you've done, and don't come back until you've learned your lesson!

Admittedly, there were some contrarians who liked Windows 8 on the desktop, but they're the same sort of masochists who pop up in online comment sections saying that Prometheus is the best Alien film, or that Metallica's St Anger isn't really that bad. Whether a few people liked Windows 8 or not, though, it was generally a disaster for desktop users, with many PC makers still having to offer Windows 7 as an option when ordering. But now Windows 10 is now finally out, and Microsoft promises that it's learned its lesson.

Press Start to play

Let's start with the obvious change, which is the return of the Start menu. It may not seem like much, but this simple change is a welcome white flag of surrender to many desktop users. The Start button itself came back with Windows 8.1, but it still took you to the big Metro Start screen. This time, though, a proper Start menu pops up.

It's not quite the same as the Windows 7 menu, though, and there's still an obvious influence from Windows 8. On the left is a list of your most frequently used apps, along with software you've recently installed. Then, at the bottom of this section you'll find the Power options, access to File Explorer (Windows' new file management system), an option to go to Settings and a handy All Apps option, which takes you through all the software installed on your PC, arranged in alphabetical order.

Meanwhile, on the right is a collection of live tiles, which you can customise, removing software you don't use and adding your favourite apps. Want old Windows favourites such as Character Map, Paint and Notepad in easy reach? No problem, just drag them from the All Apps section to the right side of the Start menu. Specific live Windows apps, such as the included Weather, Mail and Calendar apps, will display live information, while normal software will just be displayed in icon format. You can also expand the Start menu like a normal window, making it as big as you like.

There's even a nod towards the people who did like the Windows 8 Start screen, as you have the option to make the Start menu full-screen if you want it, but it's disabled by default. Good.

The App Store

Likewise, you can still buy and install apps from the Windows App store, as with Windows 8, but this time they don't take up the full screen, and can easily be resized and put where you want on the desktop.

For the most part, these apps are geared towards mobile touch-screen devices, rather than the desktop. You're better off running Facebook in a browser than running the Facebook app, for example, as the latter is much more restrictive.

Also of note are the new Mail and Calendar apps, which will be universal across all Windows 10 devices, including the Xbox One and Windows phones. On the downside, they require you to sign up with a Microsoft account to use them (if you don't have one already), and Windows nags you to do so. If you have an account, though, the apps are great – they're simple to use, and you can easily add multiple accounts. You can incorporate a Google Calendar into the Calendar app, for example, and add Gmail, Hotmail and Yahoo email accounts to the Mail app, all at the same time, along with standard POP3 and IMAP mail. The apps are big, friendly-

Want old Windows favourites such as Character Map, Paint and Notepad in easy reach? Just drag them from All Apps to the right of the new Start menu
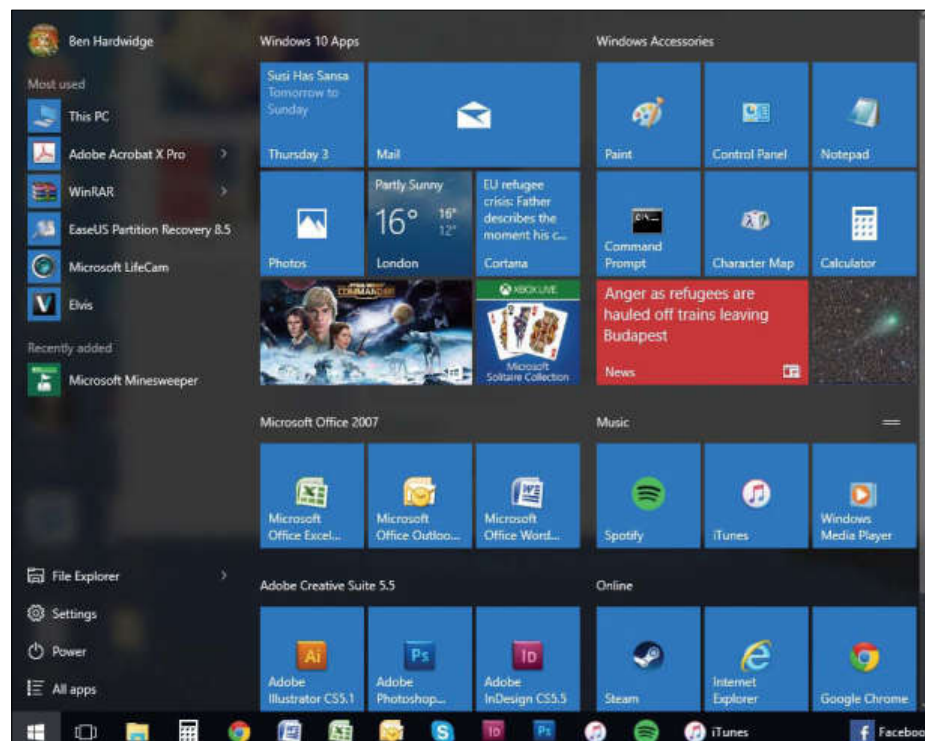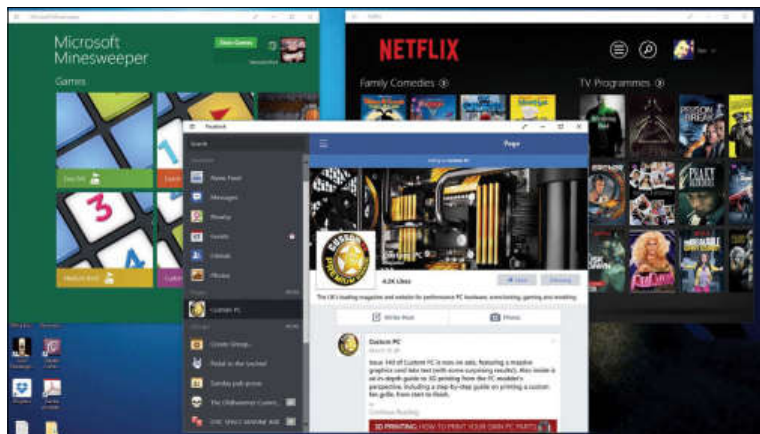
The apps can now be windowed, rather than taking up the whole screen, but they're still geared more to mobile devices than desktop PCs

looking, easy to understand and do the useful jobs you'd expect from smartphone mail and calendar apps.

Of course, the other big feature Microsoft is touting is Cortana, Windows' answer to Siri. Cortana is actually a very clever system, although you'll need to let Windows access your location information for it to work. The advertising for it pushes the voice recognition feature hard (and it works surprisingly well), but you can easily just type into it if you don't fancy talking to your PC.

Cortana is basically an organiser and search utility, and it can be very handy. You can tell it to remember meetings for appointments, start writing an email, take a note, work out sums and look up news for you. It's also a handy search tool for Windows – ask it to find files and it will do it. You can, of course, just disable it if you like. It's not an essential; it just provides an easy way to organise your life.

Cortana acts as a personal assistant and search utility

Meanwhile, all the standard Windows games are now bundled into the Xbox Live game store rather than being standard parts of Windows. You can still easily play Solitaire (Klondike) from here, but you have to install Minesweeper from the app store, and then download all 191.8MB (really) of it. The idea is that, like the apps, the games will run across all Windows 10 devices, including smartphones and the Xbox One, and you can even purchase in-game content, but it all feels a little clunky.

The basic interface

A couple of other tweaks have been made to the desktop since Windows 7. One such tweak is an expansion to the Snap feature, which previously just enabled you to effectively maximise two programs side by side on the desktop, but you can now snap apps into the four corners of the desktop too.

Also, if you snap one program into place and then leave it, you'll notice another new desktop feature popping up on the other side of it, which is the new multi-tasking interface. It shows a screenshot of every program you have open and, rather than forcing you to clunkily scroll through them one at a time, like the previous Alt-Tab or Windows-Tab systems, it shows all of them laid out at once, so you just need to click on the one you want. You can also access this feature in full-screen mode by clicking the icon next to the Start button, or simply pressing Windows-Tab.

As with Windows 8, you no longer have the fancy Aero transparency effects everywhere, with Microsoft instead pushing towards a flat user interface. You do get a transparency effect on the Start menu, though, and the dark grey here; the taskbar looks good too. Like Windows 8, the interface also feels snappy and responsive, and it boots quickly too, much more quickly than Windows 7, especially if you're using an SSD. The transition animations when you minimise and maximise windows from the Taskbar are smooth as well, and look natural without being distracting.

One more really handy feature is virtual desktops. Hit Windows-Tab, and click on New Desktop in the bottom right-hand corner and you can create a whole new desktop, with whatever software you want open at the same time. You only need to hit Windows-Tab again, and you can then flick back to another virtual desktop.

Compatibility

One worry when you're upgrading your operating system, of course, is whether your old software and hardware will work. With such a variety of different PC hardware and software available, compatibility will be a mixed bag, but we found Windows 10 very accommodating.

Not every installation went smoothly, but there was nearly always a workaround. One feature that helps is the Windows 7 compatibility mode, which comes up in the troubleshooting wizard. We couldn't get the installer for Adobe Creative Suite 5.5 to behave in Windows 10, for example, as it threw up several errors and then stopped installing. However, it worked fine in Windows 7 compatibility mode.

Likewise, Windows 10 wouldn't automatically pick up the drivers for a Microsoft webcam that was several years old by itself, but running the installer for the webcam in Windows 7 compatibility mode got it running in no time. It's also easy to add printers to Windows 10 – you hit Add Printer in the Devices section of Settings, and it will search for your printer and install it. We were amazed to see this feature work fine on our eight-year-old Samsung laser printer, without requiring any extra software.

In other respects, though, the Settings section isn't great, often oversimplifying matters for the sake of being touch-friendly, and directing you to advanced sections for activities that won't be considered advanced to many people, such as changing your display resolution. Thankfully, the classic Control Panel is still available as an option (under Windows System in the All Apps section), so we just anchored it to the Start menu for when we needed it.

The Snap feature can now snap windows into the corners of the screen, as well as the sides

Gaming

Microsoft is making a big deal about gaming with Windows 10, which is no surprise when it's going to be a part of the Xbox One ecosystem as well as the PC.

As a result, there's a feature for anyone who owns an Xbox One and a PC, enabling you to stream Xbox One games straight to your PC, which could possibly be handy if your other half or housemate is watching something unbearable on the lounge TV, enabling you to still play on your Xbox in another room.

The big news for PC gamers, though, is DirectX 12. We've yet to see any DirectX 12 games, but Microsoft is making big promises about the new API getting 'closer to the metal' and cutting out some of Windows' overheads. Considering the enormous amount of CPU and GPU processing power that PCs offer over consoles, we could potentially see some significant performance boosts to PC games.

Finally, one other gaming feature that's been added is a way to record a video of your gameplay – you hit Windows-Alt-R when you're in-game and Windows will create a standard video file of your action for easy sharing.

High resolutions

One area where Windows 7 notably failed was in scaling at high resolutions on smaller screens. Run Windows 7 on a 4k monitor and it becomes unusable, with text and icons being unusably small. Microsoft fixed this situation to a degree with Windows 8.1, but Windows 10 picks up the idea and runs with it. Firstly, you now have greater scaling options, with Windows now being able to scale your desktop by 200 per cent with a simple slider in the Display section of Settings, and even going up to 500 per cent if you go to the advanced settings in Control Panel. The Display settings slider went up to 400 per cent in some of the beta versions of Windows 10, though, and we hope this feature returns again soon.

Microsoft has also done a better job of sharpening text this time, so it doesn't look blurry, and has produced icons that scale properly for its own software too. What's more, you can set different scaling options for multiple monitors – great if you have two 27in monitors, but one is 1080p and one is 4K.

Most Windows software looks fine at 4K in Windows 10 now, and even some third-party apps such as Google's Chrome browser look fine too. There are some exceptions though. For example, Apple's iTunes software looks awful when scaled up, with blurry text and overly pixellated thumbnails of album art.
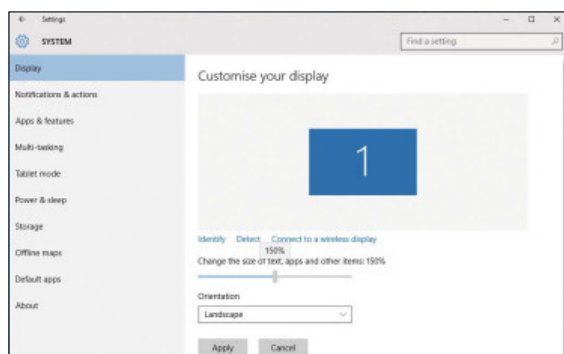
This slider in the Display settings enables you to scale up your desktop on high-resolution displays
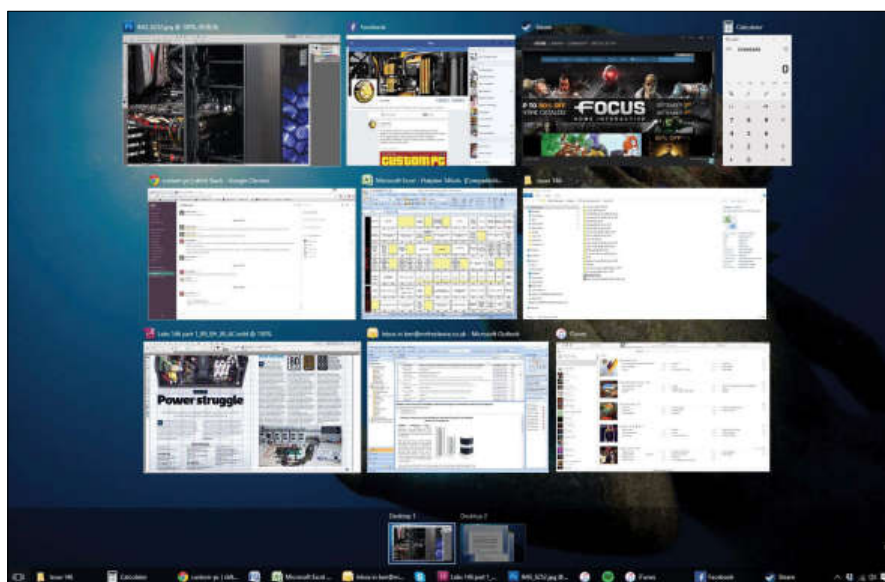
Licensing and versions

Before you upgrade to Windows 10, you'll need to figure out how best to do it. The good news is that users of Windows 7 and 8 get a free upgrade for the first year of Windows 10's lifespan, but you can't do a clean install of Windows 10 – you have to install it over the top of your current OS. We recommend doing a clean install of Windows 7 or 8 first, just to clear out any potentially problematic clutter.

Before upgrading, you also need to note that Windows 10 will give you the equivalent version of your old OS. If you start with Windows 7 Home Premium, for example, you'll only be able to upgrade to Windows 10 Home, not Pro. For most consumers, Windows 10 Home will be fine, and like Windows 8, it supports up to 128GB of RAM – a big boost over the 16GB supported by Windows 7 Home Premium.

The same goes for 32-bit and 64-bit Windows – if you want to upgrade to Windows 10 for free 64-bit, your version of Windows 7 or 8 also needs to be 64-bit. The other option is to pay for Windows 10 upfront, and you can now buy a retail version on a USB thumb drive for £88 inc VAT, saving you the hassle of faffing around with slow optical media.

Conclusion

Windows 10 is a very welcome upgrade, tweaking the interface in ways that are genuinely useful, rather than counter-intuitive, and giving users of Windows 7 Home Premium a free way to access more than 16GB of RAM. Its support for high-dpi displays is also improved over previous versions of Windows, even if it still isn't perfect, while the new Start menu banishes the horror of Windows 8's Start screen. Meanwhile, DirectX 12 promises improved gaming performance.

The end result may not be a huge leap from Windows 7, but Microsoft has clearly learned its lessons from Windows 8, and it's great to see Microsoft producing an OS that's appropriate for use on a desktop. It's a shame to see features such as Media Center disappearing, and there's also been a lot of fuss in the media about the privacy issues surrounding Wi-Fi Sense, but you can always disable and tweak Wi-Fi Sense, and disable Windows' access to your location too.

If you're using Windows 7 or 8, then we recommend getting your free upgrade to Windows 10. It feels good to be able to give Windows a thumbs up again. Welcome back, Microsoft.

BEN HARDWIDGE

Reach for the Skylake

Thinking of building a new PC based on Intel's new Skylake CPUs? Antony Leather takes a look at several Z170 motherboards, analyses the integrated graphics performance and shows you how to build a great Skylake gaming system

Z170 MOTHERBOARDS

Asus Maximus VIII Hero / **£173** inc VAT

SUPPLIER www.novatech.co.uk

While Asus' new Hero lacks the metal PCI-E slot shrouds included with both the Gigabyte Z170X-Gaming 7 and MSI Z170A Gaming M5, Asus has finally changed the red and black colour scheme of its ROG offerings.

The Hero's heatsinks sport an elegant dark grey coating, while the board has red details and a black PCB. The large plastic shroud that covers the I/O panel also extends down to the audio circuitry and gives the Hero a racy look that's a little subtler than the Gigabyte board. In addition to the new colour scheme is RGB lighting control, which enables you to alter the colour and lighting mode of the chipset heatsink's LED using a downloadable software program.

Layout is very similar to the other two boards on test, although MSI has included an extra 1x PCI-E slot, while both the other boards on test offer an extra M.2 port compared with the Hero's lone connector beneath the lower 16x PCI-E slot.

Thankfully, while the MSI Z170A Gaming M5 lacks a number of overclocking and testing tools, the Hero includes them all, with power, reset and clear-CMOS switches as well as a POST code display. Meanwhile, an addition to many of Asus' Z170 boards is a dedicated water-cooling pump header, and while it can only be used with all-in-one liquid coolers, it's a useful feature that eliminates any worry that your motherboard's fan control system might interfere with pump performance.

> You can alter the LED heatsink lighting using software

Both USB 3.1 (now called USB 3.1 Gen 2 by some manufacturers) Type-A and Type-C connectors are included on the I/O panel, along with six USB 3 ports. You also get ten SATA 6Gbps ports, although two of them are controlled by an ASMedia controller that will be slower than the Intel-controlled ports.

The Hero's EFI is top-notch too, and continues an identical theme and layout to its predecessors, featuring easy one-page access to the most popular overclocking settings and an excellent fan control suite. You also get built-in SSD secure erase, Internet BIOS flashing from within the EFI plus useful features such as USB BIOS Flashback and CrashFree BIOS, while features such as RAMDisk and Keybot have been given extensive makeovers too.

Performance-wise, the Hero was a clear winner. We loaded the XMP profile for stock speed performance, which sets the memory at XMP speeds, but also applies a few CPU tweaks, and it resulted in the fastest results in our RealBench suite and game tests. It also managed the fastest speeds with our Kingston HyperX Predator M.2 SSD too, with its read speed of 1,410MB/sec being more than 60MB/sec faster than the Gigabyte Z170X-Gaming 7. We used Rightmark Audio Analyser to test the on-board audio, where it offered a dynamic range of 104.7dB(A) and noise level of -104.8dB(A) – the best results on test, albeit by 5dBA or so. It was a fantastic overclocker too, and the first board we've tested to reach 4.9GHz with our Core i7-6700K with a 1.4V vcore, again topping the performance graphs.

Conclusion

The Maximus VIII Hero is fast, overclockable, loaded with features, and offers customisable lighting and an excellent EFI. It might cost £23 more than the MSI Z170A Gaming M5, but it does enough to justify the extra outlay and more. It's still pricey, though, so if you want a much cheaper board, hold out for our full Z170 Labs test next month.

SPEED	FEATURES
39/40	26/30

VALUE
23/30

OVERALL SCORE
88%
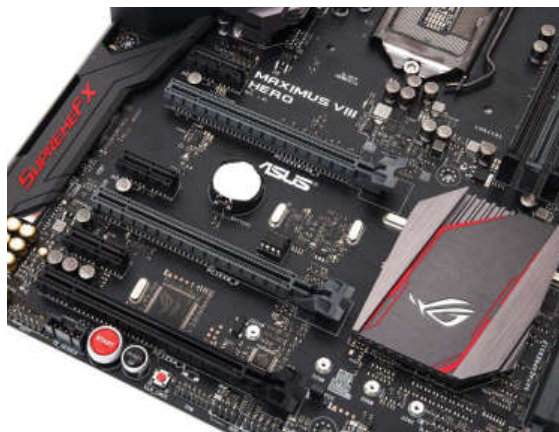
Gigabyte Z170X-Gaming 7 / **£168** inc VAT

SUPPLIER www.scan.co.uk

Boards from Gigabyte's Gaming range now sport a predominantly red and white colour scheme, giving the Z170X-Gaming 7 a great racy look, with a huge white plastic shroud covering much of the left side of the PCB. Hidden under this shroud you'll also find a multi-colour lighting system that's configurable in the EFI. There are PCI-E slot metal shrouds too, which also look fantastic, and Gigabyte has included silver SATA cables too – whether you like these touches depends on your taste, though, and some folks may find them a little garish.

In terms of features, the Gigabyte is similar to the Asus, except the Z170X-Gaming 7 offers two M.2 and SATA Express connectors. Otherwise, both boards have three 16x PCI-E slots and three 1x PCI-E slots, along with the full complement of overclocking and testing tools that are missing on the MSI board. The Gaming 7 includes two LAN ports as well, made by Intel and Qualcomm respectively. Both Type-A and Type-C USB 3.1 ports are included as well, with dual USB 3 and USB 2 headers on the PCB.

Both boards also offer uprated audio circuitry, with Gigabyte opting for a Creative system. The Gigabyte board also offers eight SATA 6Gbps ports in total, although two of them are provided by an ASMedia controller and should be avoided with modern SATA 6Gbps SSDs, as they're much slower than their Intel-based equivalents.

Meanwhile, layout is generally excellent, although the top M.2 slot will likely be obscured by large CPU coolers while the lower will suffer the same issue with dual-slot graphics cards. The Hero, on the other hand, has its lone M.2 port located beneath the second 16x PCI-E slot for easier access, at least with single-GPU setups, plus it can handle up to 110mm SSDs, while the Gaming 7's slots are limited to 80mm cards.

Sadly, though, the Gaming 7 lagged behind the MSI Z170A Gaming M5 in last place in our performance results, despite enabling the XMP profile in the EFI, although the Gaming 7 did also have the lowest power draw on test. The audio performance was good using our standard settings, with similar performance to that of the MSI board, although it wasn't quite as good as the Asus Hero board.

This still wasn't enough to topple the MSI in every test though, despite an advantage in clock speed.

Conclusion

The Z170X-Gaming 7 is a solid and feature-packed motherboard. It looks great and trumps the MSI board in a number of areas, including overclocking, but you'll need to spend some time tweaking the settings as the default XMP profile and EFI defaults didn't yield competitive performance, especially at stock speed.

However, the Asus Maximus VII Hero only costs a small amount more than this Gigabyte board, and is superior in a number of areas, even if it doesn't have the Gigabyte's two M.2 connectors.

SPEED	FEATURES
36/40	25/30

VALUE
23/30

OVERALL SCORE 84%

Meanwhile, overclocking was easy thanks to the inclusion of loadline calibration adjustment, which our Core i7-6700K sample loves, and 4.8GHz was an easy target. The EFI could do with some work in terms of ease of use though, compared with both MSI and Asus' offerings. Also, the extra 100MHz in clock speed over the overclocked MSI board still wasn't enough to beat it in our performance tests.

Sadly, we couldn't quite hit 4.9GHz, as temperatures hit a wall before we could apply enough voltage to make it stable.

MSI Z170A Gaming M5 / £150 inc VAT

SUPPLIER www.ebuyer.com

M SI's Z170A Gaming M5 is the cheapest motherboard on test this month, and it's noticeably less aesthetically bolstered than either the Asus Maximus VIII Hero or Gigabyte Z170X-Gaming 7. It lacks the I/O panel shrouds of the other two boards and its power circuitry heatsinks aren't connected via a heatpipe either. However, MSI has seen fit to include PCI-E slot shrouds, and MSI's red and black colour scheme still looks good.

There are two M.2 ports – one more than the Hero although, like the Gaming 7, they're both limited to 80mm SSDs. The lower slot is better placed than that on the Gaming 7, though, so it's still accessible with two-way graphics card setups. Both USB 3.1 Type-A and Type-C ports are present on the I/O panel too.

There are six SATA 6Gbps ports, all provided by the Z170 chipset, plus two SATA Express ports, and the Gaming M5 also sports an extra 1x PCI-E slot over the other two boards.

Layout is good too, but there are a few notable features missing. There are no overclocking or testing tools, except for an LED POST code display – on-board power, reset and clear-CMOS clear buttons are all absent and even the front panel header lacks labels, meaning you have to reach for the manual when connecting your case's cables.

Both the other boards include an Intel Gigabit LAN port, but MSI has chosen a Killer E2400 controller instead, while it has also beefed up the on-board audio with dual headphone amplifiers, uprated audio capacitors and a noise-isolated PCB. The EFI claws back some ground too, with a snappy, clear and well-laid out interface that was easier to use than Gigabyte's EFI and there's a proper fan control suite too. However, there's a notable lack of a loadline calibration

adjustment feature, hampering overclocking, which we'll cover in a minute.

The Z170A Gaming M5 performed well at stock speed with its XMP profile loaded and other settings at defaults, resulting in noticeably quicker results than the Gigabyte board, but not as rapid as the Hero. Its load power consumption at stock speed was high as a result though. Audio performance was good too, and certainly better than generic on-board audio, which typically achieves dynamic range and noise levels in the region of 90dB(A) and –90dB(A) respectively – the Z170A Gaming M5 was closer to 100dB(A) on both, although the Hero was even better in this respect.

Overclocking was disappointing, though, as we could only reach 4.7GHz with a comparatively high 1.36V due to the lack of loadline calibration adjustment – a tweak that really helps our Core i7-6700K reach higher clock speeds. Even pushing the vcore well over 1.4V and tweaking other settings didn't yield stability above this frequency. Even so, it still beat the Gigabyte board in some tests, despite its lower clock speed.

all the time anyway. The lack of physical tools on the PCB and fewer aesthetic additions are disappointing, but the Z170A Gaming M5 is worth considering if £150 is your limit. However, if you're on a tight budget, we suggest waiting for our full Z170 Labs test next month.

Conclusion

There's a lot to like about the Z170A Gaming M5 – it has two M.2 ports that support RAID for some particularly rapid storage setups if you have the cash, plus it has an excellent EFI. The latter is marred by lacklustre overclocking, but in reality, you probably won't want to run your CPU at 4.7GHz

SPEED 38/40

FEATURES 23/30

VALUE 24/30

OVERALL SCORE 85%
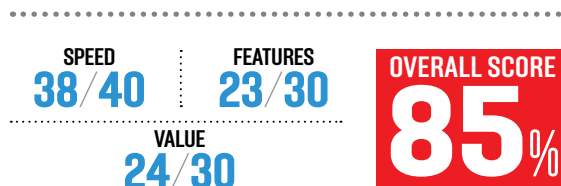
CPC MEDIA REALBENCH 2015

GIMP IMAGE EDITING

Asus Maximus VIII Hero	62,887 / 71,688
Gigabyte Z170X-Gaming 7	56,869 / 66,951
MSI Z170A Gaming	59,669 / 66,847

Scale: 0, 22,000, 44,000, 66,000, 88,000

HANDBRAKE H.264 VIDEO ENCODING

Asus Maximus VIII Hero	303,271 / 340,432
Gigabyte Z170X-Gaming 7	285,775 / 331,416
MSI Z170A Gaming	296,909 / 330,357

Scale: 0, 100,000, 200,000, 300,000, 400,000

HEAVY MULTI-TASKING

Asus Maximus VIII Hero	170,647 / 177,344
Gigabyte Z170X-Gaming 7	156,715 / 175,997
MSI Z170A Gaming	168,148 / 179,819

Scale: 0, 55,000, 110,000, 165,000, 220,000

SYSTEM SCORE

Asus Maximus VIII Hero	137,726 / 150,727
Gigabyte Z170X-Gaming 7	128,200 / 146,624
MSI Z170A Gaming	134,706 / 147,944

Scale: 0, 45,000, 90,000, 135,000, 180,000

INTEL REFERENCE

Asus Maximus VIII Hero	120.3% / 131.7%
Gigabyte Z170X-Gaming 7	112% / 128.1%
MSI Z170A Gaming	117.7% / 129.2%

Scale: 0, 40, 80, 120, 160

Legend: Stock speed / Overclocked

TOTAL WAR: ATTILA
1,920 x 1080, 0x AA, Quality setting

	Stock	Overclocked
Asus Maximus VIII Hero	58fps 69fps	60fps 70fps
Gigabyte Z170X-Gaming 7	57fps 67fps	60fps 70fps
MSI Z170A Gaming	57fps 67fps	59fps 70fps

Scale: 0, 18, 36, 54, 72

Legend: Stock speed min / Stock speed avg / Overclocked min / Overclocked avg

IDLE POWER CONSUMPTION

Asus Maximus VIII Hero	61W / 73W
Gigabyte Z170X-Gaming 7	46W / 74W
MSI Z170A Gaming	51W / 63W

Scale: 0, 20, 40, 60, 80 — Lower is better

LOAD POWER CONSUMPTION

Asus Maximus VIII Hero	126W / 196W
Gigabyte Z170X-Gaming 7	123W / 173W
MSI Z170A Gaming	140W / 158W

Scale: 0, 50, 100, 150, 200 — Lower is better

Legend: Stock speed / Overclocked

M.2 PERFORMANCE (MB/SEC)
CrystalDiskMark Sequential test

Asus Maximus VIII Hero	666 / 1,410
Gigabyte Z170X-Gaming 7	660 / 1,349
MSI Z170A Gaming	664 / 1,368

Scale: 0, 400, 800, 1,200, 1,600

Legend: Read speed / Write speed
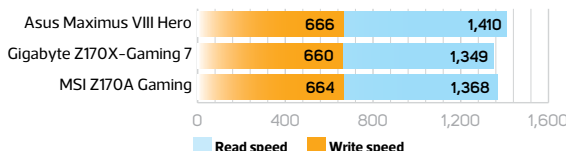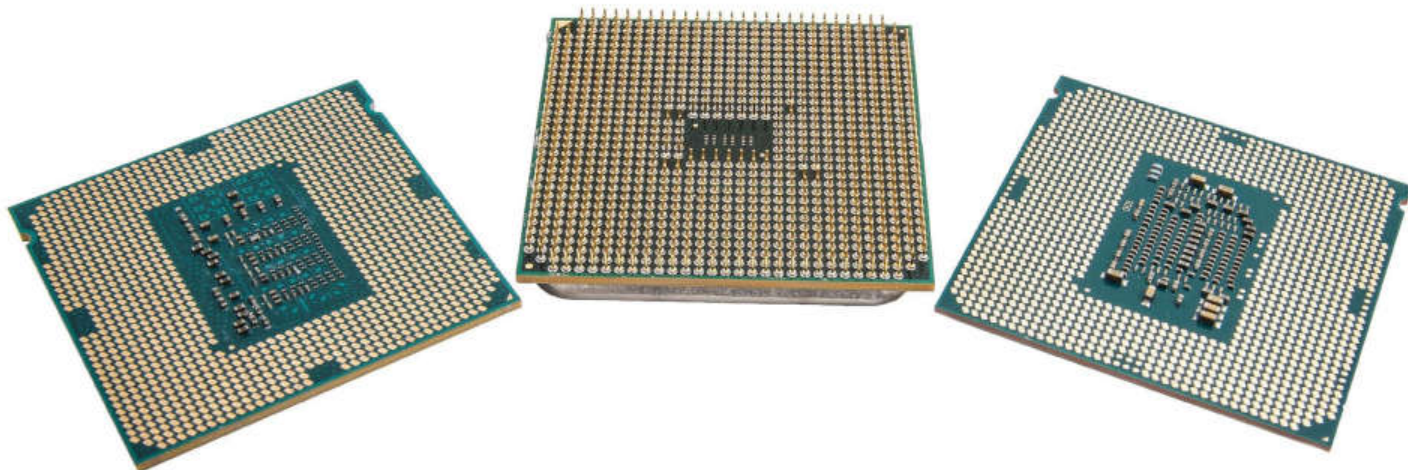
Integrated graphics

Can Intel really take on AMD when it comes to integrated graphics?
We pitch Skylake's IGP against the GPU in AMD's latest Kaveri chips to find out

Intel has reportedly made a lot of progress with its CPUs' integrated graphics and, let's face it, this wouldn't take much, but can Intel really take on AMD at its own game? To find out, we're testing the gaming performance of the GPU in AMD's A10-7870K against the one in Intel's new Core i5-6600K. In addition, we're also testing the Core i5-4690K to see how Intel's integrated graphics have improved during the transition from Haswell to Skylake.

But let's start with a little background information. The Core i5-4690K sports Intel's HD Graphics 4600 system, which is used in many Haswell CPUs, with the base and Turbo GPU core frequencies varying between them.

The Core i5-4690K's GPU can boost up to 1,200MHz, while the Core i7-4790K stretches out an extra 50MHz. It offered a respectable upgrade from the previous-generation HD 4000 graphics system included with Ivy

BioShock Infinite is playable at 1080p on the AMD A10-7870K at Low detail, but the Skylake IGP can't quite manage it

Bridge CPUs, with the total count of execution units rising from 16 to 20.

With Skylake, there's a name change as well as a tweaked GPU core. The HD 530 graphics system uses the so-called Gen9 architecture, and while the Core i5-6600K's GPU core boosts to 1,150MHz, which is 100MHz less than its Devil's Canyon predecessor, the execution unit (EU) count has risen again to 24, made up of three sub-slices. These slices each sport eight EUs and can access 768KB of L3 cache per slice – an increase of 50 per cent over previous designs. The architecture is scalable up and down too, so future Pentium and Core i3 models will offer 12 and 18 EUs, while future CPUs look likely to offer up to 72 EUs; Intel is clearly looking to ramp up its IGP performance significantly.

In terms of DirectX support, the 6600K and 6700K both cater for DirectX 12, although yet-to-be-released models may dip back into DirectX 11 territory – namely, cheaper Core i3s and Pentiums. In terms of resolution, a lot has been stated about the Skylake IGP's support for 4K resolutions, with regards to HDMI 2.0 and three-way 4K 60Hz support. In short, HDMI 2.0 isn't supported as standard but you can use a DisplayPort to HDMI 2 adaptor, so the number of 4K screens you can connect will depend on your motherboard. Thankfully, you should be able to use a DisplayPort to HDMI 2 adaptor to output 4K at 60Hz for compatibility with new 60Hz 4K TVs, while outputting from to a 4K screen is possible out of the box using DisplayPort.

IGP performance

We had issues getting The Witcher 3 and Crysis working on our Windows 10 install using integrated graphics, so we've selected three of our usual game tests for benchmarking – Alien: Isolation, Battlefield 4 and BioShock Infinite.

We aimed to achieve playable or near-playable frame-rates with the most powerful entrant in the group – the A10-7870K, so we've adjusted all games to 1080p with no anti-aliasing, with BioShock Infinite at Low detail, Alien: Isolation at High settings and Battlefield 4 at the Low preset. We also

The total count of execution units has risen to 24, made up of three sub-slices, each with access to 768KB of L3 cache

used 2666MHz DDR4 memory with the Core i5-6600K, and 2400MHz DDR3 memory with the other chips.

The biggest performance increase was in BioShock Infinite, with the Core i5-6600K managing a minimum of 22fps compared to 15fps for the Core i5-4690K. There was a big difference in Alien: Isolation too, but not much in Battlefield 4. However, the A10-7870K still rules the roost with a sizeable advantage in all three tests, despite using slightly slower memory than the Skylake system.

The future for APUs?

When it comes to ditching a discrete GPU, AMD still holds the crown when it comes to budget gaming systems. However, early performance benchmarks of the new Iris Pro GPU in Intel's Broadwell systems suggest that it performs even quicker than AMD's APUs in games, so Intel may well have the technology to beat AMD. That said, Broadwell CPUs are in short supply, and they cost significantly more than the A10-7870K too, as does the Skylake CPU on test.

However, Intel continues to turn the vice on AMD's performance advantage and its embedded DRAM or eDRAM means it doesn't suffer the same dependency on
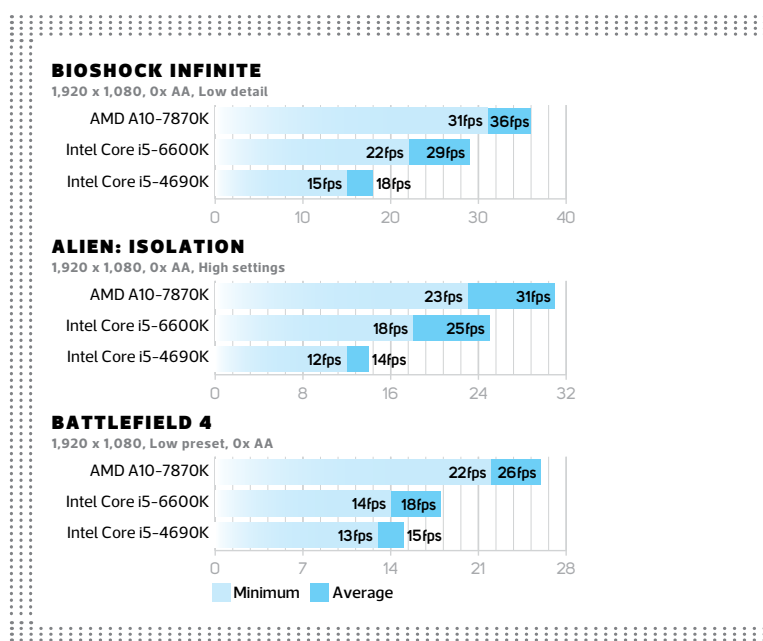
RAM speed as AMD's APUs. AMD does have plans to introduce its own version of eDRAM, but the latest news is that the next batch of APUs, known as Carrizo, won't replace Kaveri desktop APUs, but will instead be mobile parts, with a true Kaveri replacement due later next year. Intel's clearly making a lot of progress with its IGP performance, and while AMD still has a clear lead in the budget IGP stakes for now, it risks losing its advantage if we don't see any new desktop APUs in the next year.

BIOSHOCK INFINITE
1,920 x 1,080, 0x AA, Low detail

AMD A10-7870K	31fps 36fps
Intel Core i5-6600K	22fps 29fps
Intel Core i5-4690K	15fps 18fps

(0, 10, 20, 30, 40)

ALIEN: ISOLATION
1,920 x 1,080, 0x AA, High settings

AMD A10-7870K	23fps 31fps
Intel Core i5-6600K	18fps 25fps
Intel Core i5-4690K	12fps 14fps

(0, 8, 16, 24, 32)

BATTLEFIELD 4
1,920 x 1,080, Low preset, 0x AA

AMD A10-7870K	22fps 26fps
Intel Core i5-6600K	14fps 18fps
Intel Core i5-4690K	13fps 15fps

(0, 7, 14, 21, 28)

Minimum   Average

Build a Skylake PC

FOR £1,139 INC VAT

We show you how to put together an awesome Skylake gaming machine for just over a grand, and guide you through the component choices

Shopping list

CPU
Intel Core i5-6600K / £200 inc VAT
SUPPLIER www.box.co.uk

The Core i5-6600K is the cheapest LGA1151 CPU around right now, so if you don't intend to overclock your CPU, it will be worth waiting for a non K-edition CPU to turn up. However, as Skylake CPUs are very overclockable, the Core i5-6600K is a good choice if you don't need the extra multi-threaded performance provided by the Core i7-6700K's support for Hyper-Threading.

MOTHERBOARD
Asus Maximus VIII Hero / £173 inc VAT
SUPPLIER www.scan.co.uk

The Asus Maximus VIII Hero is our favourite Z170 motherboard so far. It offers a tonne of features, it's a great overclocker and it sports excellent on-board audio too.

MEMORY
16GB 2666MHz Corsair Vengeance LPX DDR4 / £101 inc VAT
SUPPLIER www.ebuyer.com

For most tasks, including gaming, 8GB of RAM will is enough, but having 16GB will help to future-proof your PC, and give you plenty of headroom when you have multiple programs open. As 2666MHz kits don't cost much more than slower kits, it makes sense to opt for this speed, as it makes a small difference to performance. You'll see diminishing returns above this speed though.

GRAPHICS CARD
MSI GTX 970 Gaming Twin Frozr V 4GB / £275 inc VAT
SUPPLIER www.ebuyer.com

If gaming at 2,560 x 1,440 is on the cards then the best tool for the job is Nvidia's GTX 970 – if you're a 1080p gamer, though, then you could save some cash by opting for AMD's Radeon R9 380X. We've chosen MSI's GTX 970 Gaming Twin Frozr V 4GB, which is fast, pre-overclocked and sports plenty of overclocking headroom; its fans are super-quiet too, even switching off under light loads.

CPU COOLER
NZXT Kraken X41 / £80 inc VAT
SUPPLIER www.novatech.co.uk

NZXT's Kraken X41 offers slightly better cooling and noise levels than many other all-in-one liquid-coolers, thanks to its larger radiator and fan. It includes great control software too, but beware of your case's mounts – you'll need a free 140mm fan mount that has at least 70mm of clearance to fit the fan and radiator above your motherboard, while mounting it in a rear fan mount requires a 173 x 140mm space.

CASE
Cooler Master Cosmos SE / £125 inc VAT
SUPPLIER www.cclonline.com

Our recent case Labs test revealed a sub-£150 winner – the Cooler Master Cosmos SE. It's a large, very capable case that offers excellent cooling out of the box, as well as enough expansion possibilities to cater for water-cooling systems, extensive storage arrays and large graphics cards.

STORAGE
256GB Crucial BX100 / £64 inc VAT
SUPPLIER www.ebuyer.com

There are plenty of super-quick SSDs available, but PCI-E storage remains prohibitively expensive for a system costing less than £1,500. Meanwhile, the latest M.2 SSDs such as Samsung's SM951 are twice the price of SATA 6Gbps SSDs, so while they're fast, you pay a massive premium. As such, we've chosen Crucial's 256GB BX100 for this build, which will still be plenty fast enough, and you can opt for the 500GB version for another £65.

2TB Seagate Barracuda /
£54 inc VAT
....
SUPPLIER www.scan.co.uk

Our 256GB SSD will be fine for accommodating Windows, plenty of software and a few games, it won't leave much space for data storage. If you have a large media library, for example, then a hard disk is still an important component in a reasonably priced PC. We've opted for our current Elite list drive – Samsung's 2TB Barracuda.

PSU
Corsair CS550M /
£67 inc VAT
....
SUPPLIER www.scan.co.uk

Nvidia's GPUs and Intel's CPUs are now so power-efficient that most mid-range systems struggle to draw more than 300W from the wall. Our setup came in at 284W under full load, so a 500W PSU is perfectly fine. We're using Corsair's semi-modular CS550M for this build.

Total: £1,139 inc VAT

Assembling the PC

1 / TEST HARDWARE
Always test your hardware outside of a case first – you don't want to find your motherboard is DOA once you've built your PC. Be sure to place your motherboard on a non-conductive surface – wood or cardboard are perfect. You can use the reference cooler that comes with your CPU to save time.

2 / INSERT CPU
Slide out the socket handle, lift it up and pull up the socket lid. Then, with the CPU between your fingers, move your hand down to the socket off to one side and then move the CPU over the socket before lowering it into place. That way, if you do drop it, it will fall flat, and it's less likely to damage anything from this low height.

3 / INSERT RAM
Flip down the clips on either sides of the memory slots, put the module in place, and push it down – when it's in place, the clips will automatically flip up and you'll hear a click. DDR4 memory has different slot locations compared with DDR3, so if you're trying to force the DIMM into the slot with no success, it's probably the wrong way round.

4 / INSTALL COOLER BACKPLATE
Now's the time to install the CPU cooler backplate on the back of the motherboard, as this job can be tricky once the motherboard is installed. Secure it in place using the cooler mounting screws.

5 / INSTALL MOTHERBOARD IN CASE
Install the motherboard's I/O backplate into your case, and check that your case's motherboard tray has standoffs installed in the correct places for your motherboard, so its solder points don't short-circuit on the metal below. You can then install your motherboard.

6 / FIT FANS ON COOLER
Most all-in-one liquid coolers require you to fit their fans, so go ahead and do this now before you install the radiator. In our case, we'll be fitting the fan from the top, screwing the radiator into position at the same time.

7 / REMOVE CASE'S TOP FASCIA

The Cosmos SE has room for the 140mm Kraken X41, but only in the roof, plus you'll need to mount the fan in the top section underneath the fascia too – there isn't enough room between the motherboard and the top of the case for both the radiator and fan.

8 / TEST-FIT RADIATOR

Place the X41's radiator above the motherboard to see how it fits and where you should mount it. The Cosmos SE has two 140mm fan mounts in the roof and you can use either of them.

9 / INSTALL RADIATOR

Place the fan in the roof. We've installed it so that it draws air through the radiator and expels it out the top.

10 / MOUNT COOLER ON MOTHERBOARD

The pump section secures to the mounting pins using four thumbscrews. Most all-in-one liquid coolers have thermal paste pre-applied, including the X41.

11 / CONNECT COOLER POWER

The Hero motherboard has a dedicated water-cooling pump connector, where you should hook up the Kraken X41's power cable. You can use a normal fan header if you're not using this motherboard, but make sure you disable fan control in the EFI to ensure the fan headers are supplying maximum voltage.

12 / CONNECT COOLER FANS

The Kraken X41 offers two 4-pin fan headers – connect the radiator fan to one of these headers so you can control it using NZXT's software.

13 / INSTALL PSU

Install the PSU with the fan facing downwards and secure it to the rear of the case. You can then connect the cables you need to power your system. If your PSU is modular or semi-modular, like the Corsair PSU we're using, you can leave out some connectors to reduce clutter if you don't need them.

14 / CONNECT MOTHERBOARD POWER CABLES

There are two PSU cables you'll need to attach to the motherboard – the 24-pin ATX connector and the 8-pin EPS 12V CPU connector. The latter is best routed behind the motherboard tray, over the top of it then down to the connector on the motherboard.

15 / REMOVE INTERNAL DRIVE MOUNT

The Cosmos SE has many storage bays, some of which restrict the length of graphics cards you can use. You'll need to remove the one adjacent to the first 16x PCI-E slot so the MSI GTX 970 will fit.

16 / INSTALL GRAPHICS CARD

The graphics card will slot into place, but be sure to secure it with thumbscrews at the expansion slot end.

17 / CONNECT POWER CABLES

You'll need two power cables from the PSU to the graphics card. Our MSI GTX 970 card has one 8-pin and one 6-pin connector, so we passed the appropriate cables from the PSU through the routing holes in the bottom of the case, then popped them out again halfway up before connecting them to the graphics card.

18 / INSTALL HARD DISK AND SSD

Mount your hard disk into one of the drive bays and then install your SSD. We opted to mount it behind the drive bays in the dedicated SSD mount.

19 / CONNECT CASE FRONT PANEL PLUGS

You case will have many cables for connecting your motherboard's USB and front panel headers. Usually, there's a USB 3 header, audio header and several small connectors for the power button, reset switch and power LEDs – they're usually labelled, but consult your motherboard manual if not.

20 / CONNECT CASE FANS

You can connect your case fans to your motherboard or via 4-pin Molex connectors to your PSU. The Cosmos SE includes adaptors to do the latter, which can be daisy-chained from a single Molex connector.

21 / CONNECT SATA CABLES

Once your drives are installed, hook them up to the motherboard using the SATA cables included with your motherboard.

22 / TIDY CABLES

Tidying the cables in your PC is essential to improve airflow and to make your PC look great – after all, the Cosmos SE has a large side window to show off your shiny new hardware, and you don't want it to look messy. Route the slack of any cables around the back of the motherboard, and tie them in place with cable ties.
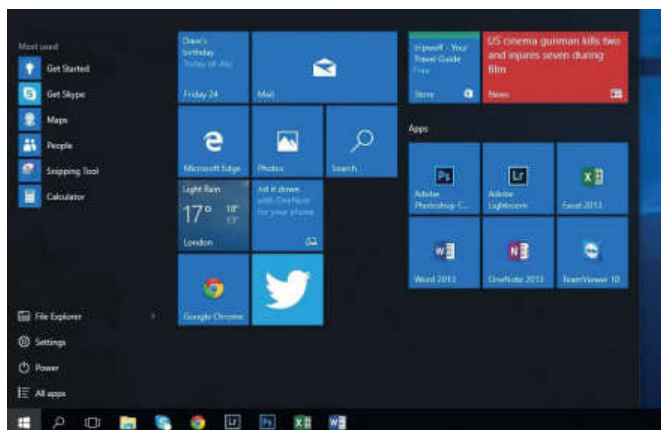
23 / INSTALL WINDOWS

If you already own a copy of Windows 7 or Windows 8, reinstall it and activate it on your new system so you can register the new Windows 10 upgrade on your new PC. That way, you'll log your free upgrade to your new PC. From there, you can reinstall afresh at any time.
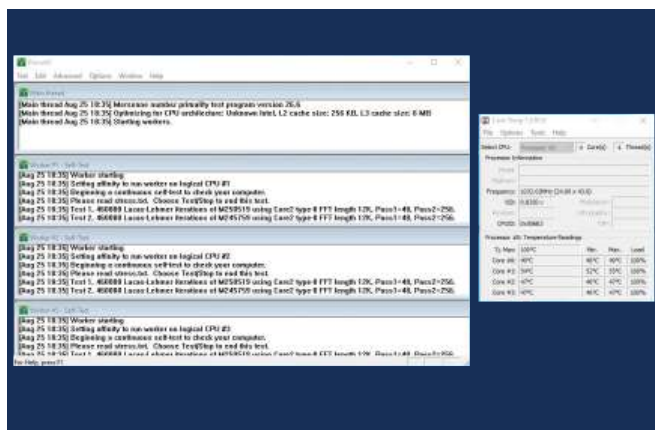
24 / CHECK TEMPERATURES

Use CoreTemp (**www.alcpu.com/CoreTemp**) and MSI Afterburner (**www. guru3d.com**) to measure the temperature of your CPU and GPU. To load your system, use Prime95 version 26.6 or below – later versions include instructions that create massive, unrealistic heatloads on newer Intel CPUs – you can find it using Google. To stress the GPU, use Unigine's Valley benchmark (**www.unigine.com**) and run both programs concurrently for ten minutes. If your CPU and GPU temperatures are below 60°C and 70°C under load, there's scope to overclock them and you can move to the next step.
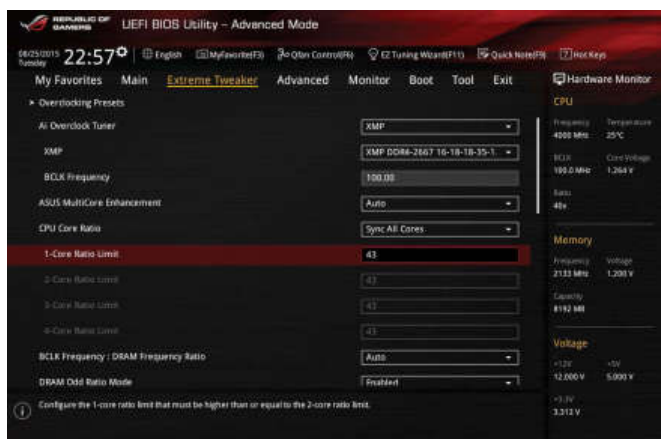
25 / OVERCLOCK YOUR CPU

Head into the EFI during the bootup process (usually by pressing the Del or F1 key) and find the Extreme Tweaker section (for Asus ROG motherboards). Here you can set the Ai Overclock Tuner to XMP mode, which will set the correct memory speed and timings, and then set the CPU core ratio to 43x and the CPU voltage to 1.25V. These settings will overclock the CPU to 4.3GHz, providing a good speed boost within safe limits.

26 / OVERCLOCK YOUR GPU

The GTX 970 is a pretty good overclocker and we've overclocked our model by 100MHz on the core and 130MHz on the memory. You can set these levels using MSI Afterburner, while at the same time raising the power and temperature limits to their maximum settings. Our overclocking yielded some handy gains in our benchmarks, raising the system score from 108,379 to 116,915. We've tested these settings thoroughly, but not all components are the same, so it's a good idea to run Prime95 and Unigine Valley again to make sure your system is stable when it's overclocked.

CPC REALBENCH 2015

**GIMP IMAGE EDITING**

| CPC Skylake PC | 57,507 | 63,257 |

0 — 18,000 — 36,000 — 54,000 — 72,000

HANDBRAKE H.264 VIDEO ENCODING

| CPC Skylake PC | 230,658 | 248,940 |

0 — 75,000 — 150,000 — 225,000 — 300,000

LUXMARK OPENCL

| CPC Skylake PC | 73,784 | 77,065 |

0 — 25,000 — 50,000 — 75,000 — 100,000

HEAVY MULTI-TASKING

| CPC Skylake PC | 130,598 | 140,050 |

0 — 40,000 — 80,000 — 120,000 — 160,000

SYSTEM SCORE

| CPC Skylake PC | 108,379 | 116,915 |

0 — 35,000 — 70,000 — 105,000 — 140,000

INTEL REFERENCE

| CPC Skylake PC | 94.69% | 102.15% |

0 — 30 — 60 — 90 — 120

■ Stock speed ■ Overclocked

MICRO-ATX CASE

Hex Gear R40 / **£200** inc VAT

SUPPLIER www.hex-gear.com / MODEL NUMBER R40-WHT-001

The custom case scene is a growing one and, with the likes of Parvum Systems carving a small but popular niche for unusual enthusiast-orientated cases, UK-based Hex Gear has now joined the fray too with its new R40. Much like EK's strategy with its concept-only Vulture case recently, the R40 was sent out to a select few modders for tinkering over the past few months, and the spectacular results, plus an interview with its makers, are covered in Customised PC (see p100).

Now, though, the case is readily available to everyone via Hex Gear's website for a slightly eyebrow-raising sum of £200 inc VAT. However, when you pick up the box, you immediately understand the price. The case sports a huge amount of aluminium – an expensive material, which makes up the side panels, several internal fittings plus the four large curved profile sections. Just the latter weigh in at 3kg, while the case in total weighs a hefty 14kg.

It's extremely sturdy as a result, although you have to build the case first – as with Parvum cases, the R40 is flat-packed and will require a few hours in DIY mode. Thankfully, the instructions are excellent, although there are numerous screw types and sizes, as well as 24 fairly involved building steps, so it isn't for the faint-hearted.

You start by applying foam tape to some of the panels to prevent vibration, then you build the motherboard tray before installing the large top and bottom fan/radiator mounts, securing the aluminium profiles and finally adding the front and rear sections. The side panels are screwless and simply slot into place for easy removal, and the end result is a fantastic-looking chassis.

The case is customisable too. It uses accent packs – acrylic inserts that sit between the main chassis and front and rear sections that add some colour. These accents are available in eight colours, and you can also get reverse ATX designs if you want to position your motherboard upside down with the window on the opposite side. The case includes nearly every part you need to build a PC, including a vandalproof power switch and clear acrylic stands to lift the chassis off the desk by an inch or so for better cooling.

The R40 is flat-packed and will require a few hours in DIY mode

There are a few omissions, though, compared with a regular case. There are good allowances for cable routing, although the holes lack grommets and you'll need to find ways of anchoring the cables behind the motherboard tray. There are no dust filters or USB ports, and while the case sports six 120mm fan mounts, the screwholes aren't big enough for standard fan screws, as they're designed for use with water-cooling radiators. In fact, the entire case is very much water cooling-orientated, although Hex Gear says it can be equally suited to air cooling too. For the moment, you'll need to acquire appropriately sized screws and nuts for air cooling, which isn't ideal, but Hex Gear is working on being able to supply the right bits, plus offering panels with fan holes big enough for standard mounting screws.

In terms of hardware, there's space for either three SSDs or two hard disks in the standard mounts, or two SSDs and a single hard disk in a mount behind the motherboard tray, keeping the main chamber as clutter-free as possible. The PSU mount is located at the front of the case in a vertical position, and includes an angled riser to route the cables inside the case. There's essentially no limit on PSU or graphics card length, although the PSU mount can end up in front of the GPU, limiting the graphics card length to 370mm. Likewise, a customisable plate that sits to the right of the motherboard, allowing for the installation of reservoirs and pumps, could also restrict the length of graphics cards. The plate itself offers a convenient place to mount your pump or reservoir, though, with Hex Gear offering optional plates that are compatible with various EK components.

Despite its size, the R40 is limited to micro-ATX motherboards, but half-height radiators can be used in the roof and base with room for double and triple 120mm-fan radiators respectively. The rear fan mount makes up the sixth fan location, although again, you'll need to use screws and nuts here to counteract the small holes, plus the

/SPECIFICATIONS

Dimensions (mm) 241 x 483 x 415 (W x D x H)

Material Acrylic, aluminium, steel

Available colours Black or white with red, blue, green, orange, purple or pink plate options

Front panel Power

Drive bays 3 x 2.5in or 2 x 3.5in

Form factor(s) Mini-ITX, micro-ATX

Cooling 1 x rear 120mm fan (fan not included), 2 x 120mm base fan mounts (fans not included), 3 x 120mm roof fan mounts (fans not included)

CPU cooler clearance Approx 165mm

Maximum graphics card length 370mm

1 Hex Gear offers optional plates that are compatible with various EK parts

2 Cable routing is good, although the holes lack rubber grommets

3 There's room in the base for a half-height triple 120mm radiator
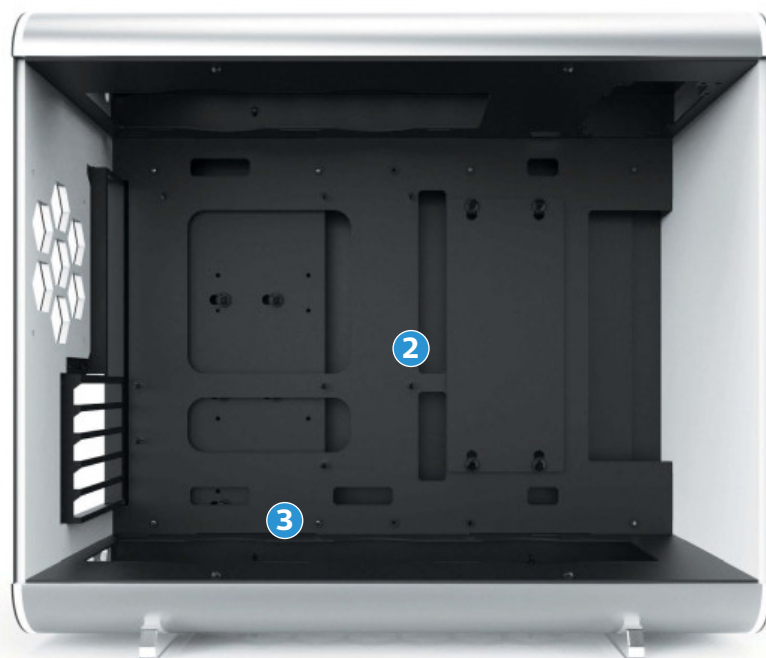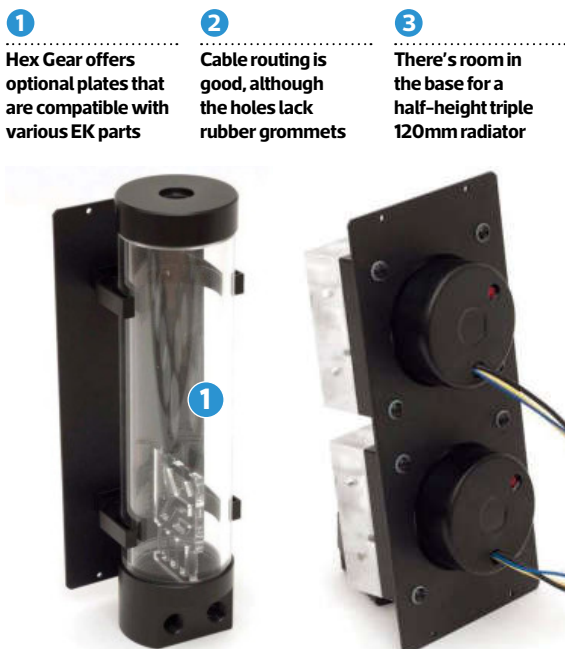
7mm-thick acrylic and aluminium. Fans aren't included either – the R40 is definitely a blank slate.

Performance

Using our standard micro-ATX test kit, along with single Corsair SP120 fans in the roof and rear as exhausts, the R40 managed a CPU delta T of 47˚C, while the GPU delta T at 50˚C sees the R40 prove itself to be a capable air-cooling case. The CPU result matched the Fractal Design Arc Mini R2, while the GPU result was level with Phanteks' Enthoo Mini XL. For such a small case, there's clearly a good amount of cooling headroom for water-cooling enthusiasts, but it's good to know the R40 can also perform well as an air-cooled case.

Conclusion

The R40 is expensive and lacks basic features you'd expect from a case costing a quarter of the price. However, it's targeted at a very niche segment of the enthusiast market.

The audience is made up of people who want an exclusive case and are prepared to pay for it – one that's customisable, water cooling-friendly and well made – and the R40 delivers on these points very well indeed. The fact that Hex Gear opted for micro-ATX means the case is compact but allows for two-way GPU systems all the way up to Intel's X99 platform, plus there's room for all the water-cooling gear to accommodate such a setup too.

We'd like to see easier fan mounting, though, plus USB ports and dust filters should be standard inclusions. Hex Gear does have some of these features in the works, but we'd like to see the case become a more attractive prospect for people other than diehard water-cooling fans with sizable wallets. As it stands, the R40 is a blank canvas for which you'll need to source some extra components to get it up and running. However, if you're an enthusiast looking for a well-designed water-cooling chassis, the end result is definitely worth it, even for £200.

ANTONY LEATHER

CPU LOAD DELTA T

Hex Gear R40	47°C
Phanteks Enthoo Mini XL	45°C
Fractal Design Arc Mini R2	47°C
	50°C

0 13 26 39 52
Lower is better

GPU LOAD DELTA T

Hex Gear R40	50°C
Phanteks Enthoo Mini XL	50°C
Fractal Design Arc Mini R2	52°C
	54°C

0 14 28 42 56
Lower is better
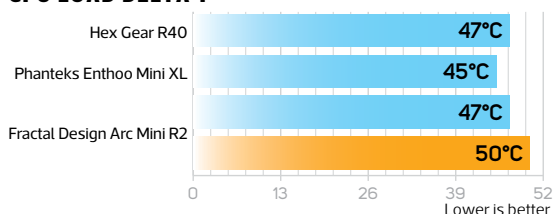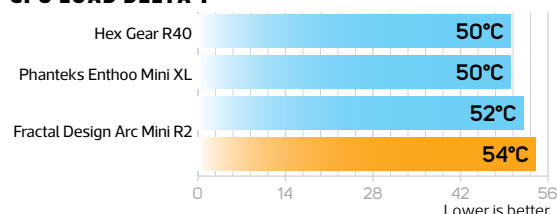
■ High fan speed ■ Low fan speed

COOLING 23/30 **FEATURES** 14/20

DESIGN 26/30 **VALUE** 14/20

OVERALL SCORE 77%

VERDICT

The R40 is expensive but a great piece of design. It's a perfect case for enthusiasts looking to build a water-cooled micro-ATX system, although it has a few caveats.

GAMING LAPTOP

Venom BlackBook 15 U02507 / **$3,098 (£1,990)**

Venom hails from Melbourne, Australia, but the firm is making a global push by offering free worldwide shipping on its laptops, with a single price in US dollars. The BlackBook 15 is its flagship machine, and the U02507 model sports an Nvidia GeForce GTX 970M GPU. This chip has a 924MHz core and 1,280 stream processors, using the same GM204 core as the range-topping GTX 980M. It also has 3GB of dedicated memory, which is fine, although Nvidia does produce a version of this core with 6GB of RAM.

The GPU is partnered with a 2.5GHz quad-core Core i7-4710HQ CPU, which hits a Turbo speed of 3.5GHz. Elsewhere, there's a 512GB Samsung XP941 M.2 SSD, a 1TB hard disk and a mighty 32GB of memory. There's also dual-band 802.11ac Wi-Fi and Gigabit Ethernet, while the external sockets include three USB 3 ports, an eSATA, mini-DisplayPort, HDMI and a card reader. There's even a SIM card slot for mobile Internet.

It's well balanced, but rival systems offer competitive power for lower prices. A version of the MSI GE72 with a GTX 970M and 4K screen costs £1,537 inc VAT, for example – it has a smaller SSD and 16GB of RAM, but that's still a significantly lower price.

In terms of style, the BlackBook lives up to its name. There are few flashing lights or extravagant features – the matt black aluminium lid has an understated logo, the interior is finished with the same plain aluminium and the screen is surrounded by a surprisingly wide bezel.

It's subtle, but it's hardly stylish. The aforementioned MSI laptop has fancy RGB lights and logos, while the HP Omen is far sleeker. Sadly, the BlackBook's build quality isn't outstanding either; most of the base is strong but the area to the left of the touchpad has too much flex and the screen's housing is a little wobbly – it moves from side to side when you flex the lid (not a likely everyday action, but a good test of the strength of a laptop's screen protection), and the rear covering across the screen feels weak.

On the plus side, you get good access to the interior; the base lifts off to reveal the cooling gear, memory slots, Wi-Fi card and storage, and there's an empty M.2 slot available as well. There's an excellent keyboard too. The buttons are snappy and fast, and their action is consistent, which is important for gaming. The WASD buttons have arrows and the unit is backlit. The keyboard has a US layout by default, though, so we've included the $99 US fee for a UK version in our sample's price.

Finally, the Venom's one-year parts and labour warranty is a worldwide deal, which is pretty minimal. Comparatively, the MSI GE72 is covered by a two-year collect and return plan.

Performance

The BlackBook returned good 1080p gaming results, although it was less convincing at the screen's native resolution of 2,880 x 1,620. Its best 1080p result was in Middle Earth: Shadow of Mordor, with a minimum of 58fps, and its 40fps minimum in Battlefield 4 is good. Crysis 3 is tougher, but it still hit a smooth minimum of 30fps, meaning all our test games are playable at 1080p.

However, while the BlackBook's 2,880 x 1,620 minimum in Shadow of Mordor was a playable 33fps, the Venom could only manage unplayable 20fps and 15fps minimums in Battlefield 4 and Crysis respectively, so you'll either need to drop the detail or resolution to get better frame rates in more demanding games.

The BlackBook's application performance is fine, though, especially in our heavily multi-threaded H.264 video encoding test, where the score of 203,438 was much better than the MSI GE72's 188,876. We've no complaints about the PCI-E-based Samsung XP941 M.2 SSD either. Its sequential read and write results of 1,101MB/sec and 747MB/sec are fantastic.

It's an impressive slate of results, but they're hampered by thermal performance. The processor's peak delta E of 76°C at load is worryingly high, and that toasty result saw the chip throttle back to 2.4GHz and the fans produce a consistent, modest whine.

A supplied app can switch the fans into Entertainment, Performance and Power-saving modes, but they made no difference to the noise output. Extended stress testing saw the left side of the keyboard and the left and central areas of the base become uncomfortably hot too. The WASD keys just about escaped, but the heat on the base will be obvious on a lap.

/SPECIFICATIONS

CPU 2.5GHz Intel Core i7-4710HQ

Memory 32GB 1866MHz DDR3

Graphics Nvidia GeForce GTX 970M 3GB

Screen 15.6in 2,880 x 1,620 IPS

Storage 512GB Samsung XP941 SSD, 1TB Hitachi hard disk

Weight 2.5kg

Ports 3 x USB 3, 1 x USB 3/eSATA, 2 x mini-DisplayPort, 1 x HDMI, 3 x audio

Dimensions (mm) 385 x 271 x 25 (W x D x H)

Operating system Windows 10 Pro 64-bit

Warranty One year parts and labour

Inconsistency marred the screen; the brightness level of 338cd/m^2 is great, but the black level and contrast ratio of 0.38cd/m^2 and 889:1 are middling – the MSI is better in both regards. The Venom's colours won't be as punchy, especially at the darker end of the scale. Uniformity is the only other issue – the screen loses between 12 and 17 per cent of its brightness along the bottom edge.

On the plus side, the colour temperature of 6,396K is almost perfect and its delta E of 2.43 is great – both of these results ensure accurate colours, and both are far better than the MSI's screen. Also, while the native resolution causes the Venom problems in games, the 2,880 x 1,620 panel works well elsewhere, with the high pixel density making text and photos look great.

Then there are the speakers, which pump out solid volume with satisfying bass and crunchy mid-range, while the Sound Blaster app can be used to switch between modes or make specific tweaks. The top end is a little tinny, but you can't expect everything from laptop speakers.

Finally, the BlackBook's battery lasted for 46 minutes when we ran a games test with the screen at 100 per cent brightness, which isn't much time for gaming on the move, but is par for the course with powerful gaming laptops – the MSI GE72's battery life was similar.

Conclusion

Venom's global business model is an interesting way to compete against the more localised manufacturers, but it needs to back that up with a high-quality machine to succeed, and the BlackBook doesn't quite cut it. It's fast in benchmarks, the screen has good colour levels, the SSD is quick and the keyboard impresses, but the build quality is inconsistent, high workloads heat up the machine to uncomfortable levels and it isn't cheap either. The BlackBook has good points, but laptops with similar power and better build quality are available for much less money elsewhere.

MIKE JENNINGS

CPC REALBENCH 2015

GIMP IMAGE EDITING

Venom BlackBook 15 — 44,371

0   12,000   24,000   36,000   48,000

HANDBRAKE H.264 VIDEO ENCODING

Venom BlackBook 15 — 203,438

0   55,000   110,000   165,000   220,000

LUXMARK OPENCL

Venom BlackBook 15 — 54,098

0   15,000   30,000   45,000   60,000

HEAVY MULTITASKING

Venom BlackBook 15 — 116,945

0   30,000   60,000   90,000   120,000

SYSTEM SCORE

Venom BlackBook 15 — 93,893

0   25,000   50,000   75,000   100,000

INTEL REFERENCE: 82.04%

BATTLEFIELD 4
1,920 x 1,080, Ultra Detail, 4x AA

Venom BlackBook 15 — 40fps / 50fps

0   16   32   48   64

2,880 x 1,620, Ultra Detail, 4x AA

Venom BlackBook 15 — 20fps / 26fps

0   7   14   21   28

SHADOW OF MORDOR
1,920 x 1,080, Ultra Detail, FXAA

Venom BlackBook 15 — 58fps / 75fps

0   20   40   60   80

2,880 x 1,620, Ultra Detail, FXAA

Venom BlackBook 15 — 33fps / 40fps

0   10   20   30   40

CRYSIS 3
1,920 x 1,080 Very High Detail, 0x AA

Venom BlackBook 15 — 30fps / 44fps

0   12   24   36   48
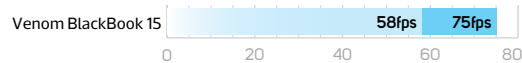
2,880 x 1,620 Very High Detail, 0x AA

Venom BlackBook 15 — 15fps / 23fps

0   6   12   18   24

■ Minimum ■ Average

SPEED	DESIGN
22/25	16/25
HARDWARE	VALUE
19/25	19/25

OVERALL SCORE
76%
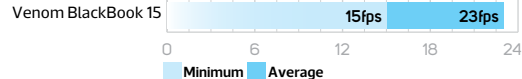
VERDICT

Powerful enough for 1080p gaming, and it has a great screen, but it gets very hot and better build quality is expected at this price.

GAMING MOUSE

Mionix Castor / **£59** inc VAT

SUPPLIER www.amazon.co.uk / **MODEL NUMBER** B011NZOJ7U

Mionix's peripherals have picked up lots of **Custom PC** awards in the past, and its mice in particular have rarely failed to impress us. They generally offer excellent comfort and ergonomics, plenty of features and reasonable prices, and the new Castor looks set to continue these trends. At £60 inc VAT, it isn't bad value for money, although the Logitech G402 is a fair bit cheaper at around £40 inc VAT.

The Castor is noticeably smaller than many of the company's other mice, such as those in the Naos range, but it still offers a soft-touch coating that keeps your hand feeling dry. It's a good couple of centimetres shorter than the G402 as well and, as a result, palm-grip users with longer than average fingers may find their fingers resting on the edge of the buttons, whereas the G402 is more spacious. Its small size means it weighs around 10g less than the G402, though, so if you're a claw or fingertip gripper that likes lightweight mice, the Castor is ideal.

There's a single dpi toggle switch located behind the mouse wheel that can flit between three configurable settings, ranging all the way from 50 to 10,000dpi in 50dpi increments. Sadly, though, the switch simply cycles through the settings and there's no visual clue as to which setting you're using. By contrast, the G402's dpi adjustment has two dedicated buttons within easier reach that can go up or down between a selectable number of presets, plus you get a visual aid.

Meanwhile, the Mionix software is relatively in-depth and clear, and allows you to set the lift distance, X and Y axis sensitivity (separately), USB poll rate, angle and lift off distance adjustment. All the buttons are programmable, with six in total available, including the near-silent scroll wheel plus two thumb buttons that are very well-placed above a textured thumb rest. You can also record (but not run) macros, while there are five profiles to save your settings – again, though, there are no visual clues as to which profile you're currently using, despite the Castor sporting customisable RGB LEDs with lighting effects, and the ability to assign a button to cycle through profiles.

Then there's the PMW-3310 optical sensor, which is wonderfully precise and we noticed no lag or acceleration, although the latter can also be programmed in software if needed. In fact, we were able to use the Castor fluently in games in just a few minutes. The finger buttons feel sturdy as well, and the mouse as a whole feels more solid than the G402.

Conclusion

The Castor feels fantastic both on the desktop and in games, but we'd expect nothing less from a Mionix mouse. It's refined, well built and has enough customisable settings to please most people, but we do have an issue with the price. At nearly £60 inc VAT, it costs considerably more than the Logitech G402, yet the latter has greater customisation and much more control over on-the-fly dpi adjustment. The Castor is better made and slightly more comfortable, especially for claw and fingertip-grip types, but for the avid gamer, the G402 offers better value for money.

ANTONY LEATHER

The optical sensor is wonderfully precise

/ **SPECIFICATIONS**

Sensor 10,000dpi optical
Connection Wired, USB
Cable 2m, braided
Materials Plastic
Extras Mionix stickers

DESIGN	FEATURES	VALUE
37/40	27/35	18/25

OVERALL SCORE
82%

VERDICT
Excellent comfort and build quality, but the cheaper competition offers more features for dpi adjustment and profiles.

BUILD YOUR
VICTORY

3D PRINT SUPPORT

BUILD YOUR VICTORY

The Nyth comes equipped with massive out-of-box configuration options, with 36.738 combinations via its 33 modular buttons, plus a variety of side-grip options to maximize gamer comfort and control. The first fully integrated 3D printable gaming mouse, the Nyth is your unique fingerprint in gaming. Configure Nyth to any PC gaming genre. MOBA, FPS and more - the Nyth is your custom gaming tool. Twin-Tech Laser Sensor R1 with up to 12000 dpi, 2-level multicolor illumination with 16.8 million colors available, the 2D Titan Wheel, ROCCAT® Swarm support, a dedicated Easy-Shift[+] key, support for ROCCAT Talk®/AlienFX™ and loads more. Future Ready means being prepared for it all.

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ROCCAT®
NYTH

MODULAR MMO GAMING MOUSE

MORE INFORMATION
WWW.ROCCAT.ORG/NYTH

GAMING MOUSE

Roccat Nyth / **£90** inc VAT

With its extremely customisable shape and feature set, even including the ability to 3D-print your own parts using your own designs, or templates available online, Roccat's Nyth isn't your average gaming mouse. Included in the box are two hot-swappable sides to change the shape. The first is a slimmer one that's well suited to claw and finger grips, while the second is a fuller, hand-filling one that's comfortable with a palm grip. Switching from one to the other takes seconds as well, thanks to the magnetic design. However, they could do with a rubber grip applied to the sides to help combat the low friction on the mouse's main body.

A modular thumb zone is also included, enabling you to install between zero and 12 thumb buttons. Individual slots are arranged in three rows of four, and you can install single or double-sized buttons as your needs dictate, and fill unused ones with inactive blanking plates. It's a clever mechanism, but working with it is fiddly – you have to release all the buttons and spacers at once using a slider on the bottom, even if you only want to make one change. Still, the numbering system helps you keep track of parts, and all the necessary bits come in a carry case for easy storage and transport.

Two hot-swappable sides change the shape

The whole zone is generally easy to reach with your thumb, but we found accurately differentiating between 12 buttons, for example, to be practically impossible – it's much easier to work with the double-sized buttons.

The Nyth itself has a soft-touch, scratch-resistant surface that make it comfortable to wield but it's also rather slippery in your hand. The Teflon feet ensure smooth movements and the 1.8m USB cable doesn't drag, although there's no adjustable weighting.

Other buttons include one at the front end of the scroll wheel, and a mid-finger fin switch behind it, which you can rock to either side, giving you two extra functions without getting in the way. However, it's much easier to trigger this switch when in a palm grip; with a claw grip your middle and index fingers are elevated above the fin rather than right next to it. The scroll wheel itself is also lovely to use, with clearly defined steps and a pleasing rubber coating.

The Nyth uses a 12,000dpi laser sensor that's adjustable in 1dpi increments. At this point, sensor resolution is turning into a numbers game, with ever higher numbers offering little tangible benefit, but the Nyth's sensor performance at realistic levels remains excellent – we didn't detect any acceleration, snapping or excessive jitter in our movements.

Adjustments are made in Roccat's Swarm software, which is fast and intuitive. Up to five resolution levels can be saved, and managing your profiles is easy. All buttons bar the two main ones can be reprogrammed to almost any function or macro, and you can give all keys a secondary programmable function, by assigning the EasyShift function to any mouse button, or a key on a compatible Roccat keyboard. Telling the software how you have the thumb zone configured is easy too, thanks to a simple drag and drop interface.

Meanwhile, the two lighting zones use RGB LEDs and can be configured with a few effects, although your hand will block most of the lighting from view in use.

Conclusion

With good build quality, solid sensor performance, flexible customisation options and intuitive, detailed software, there's a lot to like about the Nyth. At £90 inc VAT, however, it's extremely expensive and a very niche product. The number of people who will want to swap grip styles between games, rather than stick with their usual preferred shape, is arguably small, although the ability to swap different thumb button sets could be handy for folks who play both RPGs and first-person shooters. If you're looking for that level of customisation, though, the Nyth is a superb piece of engineering that uniquely fits the bill.

MATTHEW LAMBERT

/SPECIFICATIONS

Connection	Wired, USB
Sensor	Laser
Resolution	12,000dpi
Cable	Braided
Material	Plastic
Extras	None

DESIGN 35/40

FEATURES 33/35

VALUE 15/25

OVERALL SCORE 83%

VERDICT
A great piece of craftsmanship, but it's only worth considering if you truly need this level of modularity and customisation.

How we test

Thorough testing and research is the key to evaluating whether a product is worth buying, and deciding whether or not there's a better alternative
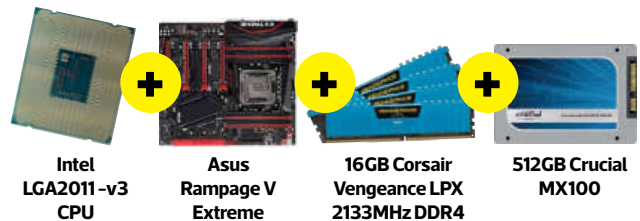
PROCESSORS

We judge CPUs on whether they offer sufficient speed for the price. Part of a CPU's speed score comes from how overclockable it is. Every type of CPU is tested in the same PC, so all results are directly comparable.

INTEL LGA1151

Intel LGA1151 CPU + **Asus Z170 Deluxe** + **16GB Corsair Vengeance LPX 2666MHz DDR4** + **256GB Samsung 850 Pro**

INTEL LGA2011–V3

Intel LGA2011–v3 CPU + **Asus Rampage V Extreme** + **16GB Corsair Vengeance LPX 2133MHz DDR4** + **512GB Crucial MX100**

AMD FM2+

AMD FM2+ APU + **MSI A88X–G45Gaming** + **16GB Corsair Vengeance Pro 2133MHz DDR3 (GPU testing)** + **8GB Corsair Vengeance Pro 1600MHz DDR3 (CPU testing)** + **240GB Crucial M500**

COMMON COMPONENTS

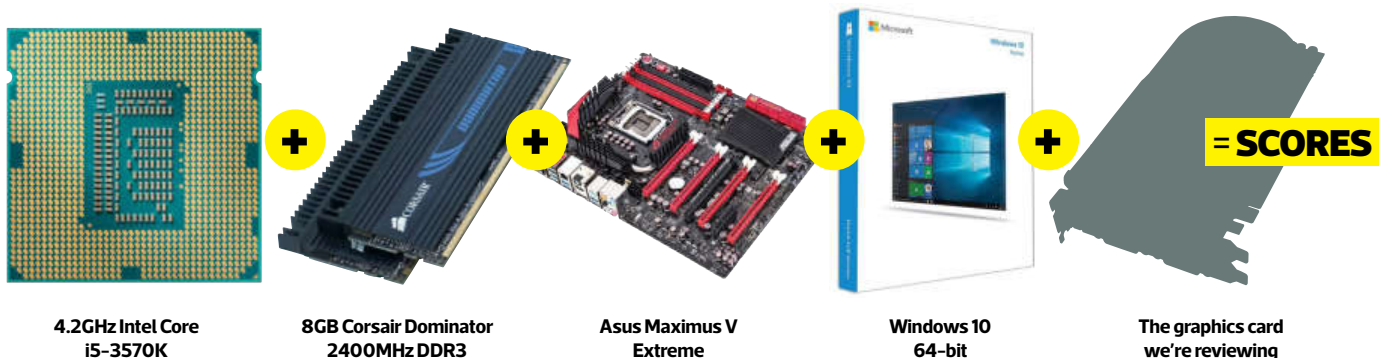**Nvidia GeForce GTX 780 3GB** + **Windows 10 64–bit**

TESTS: We use Custom PC RealBench 2015, Cinebench R11.5 and a variety of games. We also test the power draw of the test PC with the CPU installed. These tests reveal a broad range of performance characteristics, from image editing to gaming and video encoding to 3D rendering. We run all tests at stock speed and again when overclocked to its highest frequency.

*Please note: We test AMD FM2+ APUs using the on–board graphics, not the Nvidia GeForce GTX 780 3GB

GRAPHICS CARDS

Graphics cards are mainly evaluated on how fast they are for their price. However, we also consider the efficacy and quietness of the cooler. Every graphics card is tested in the same PC, so all results are directly comparable.

4.2GHz Intel Core i5–3570K + **8GB Corsair Dominator 2400MHz DDR3** + **Asus Maximus V Extreme** + **Windows 10 64–bit** + **The graphics card we're reviewing** = SCORES

CUSTOM PC REALBENCH 2015

INTEL REFERENCE

Intel Core i7–4790K **+** 16GB of Corsair 2400MHz DDR3 **+** 240GB OCZ 150 **+** Asus Maximus Gene VII **+** Nvidia GeForce GTX 780 3GB **=100%**

AMD REFERENCE

AMD A10–7850K **+** 8GB of Corsair 2133MHz DDR3 **+** 256GB Plextor M5 Pro **+** Asus A88X–Pro **=100%**
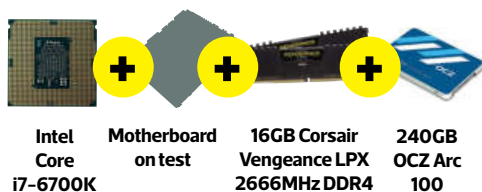
Our benchmark suite, co–developed with Asus, simulates how people really use PCs – a higher score is better. You can download them from www.asus.com/campaign/Realbench
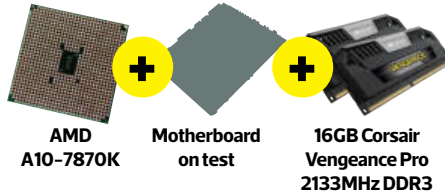
MOTHERBOARDS

Motherboards are evaluated on everything from layout and features to overclockability and value for money. Every motherboard is tested with the same components, so all results are directly comparable.

INTEL LGA1151

Intel Core i7–6700K **+** Motherboard on test **+** 16GB Corsair Vengeance LPX 2666MHz DDR4 **+** 240GB OCZ Arc 100

AMD FM2+

AMD A10–7870K **+** Motherboard on test **+** 16GB Corsair Vengeance Pro 2133MHz DDR3

INTEL LGA2011–V3

Intel Core i7–5960X **+** Motherboard on test **+** Plextor M6 256GB **+** 32GB Crucial 2133MHz DDR4

COMMON COMPONENTS

AMD Radeon R9 390X* **+** Windows 10 64–bit

TESTS: We use Custom PC RealBench 2015 and several games, and also test the speeds of the board's SATA ports. We try to overclock every motherboard we review by testing for a maximum QPI, base clock or HTT as well as overclocking the CPU to its maximum air–cooled level. We run our tests at stock speed and with the CPU overclocked.

*Please note: We test AMD FM2+ motherboards using the on–board graphics, not the AMD Radeon R9 390X

TESTS: By using the fast PC detailed on the left, we can be sure that any limitations are due to the graphics card on test, rather than being CPU limited. We test Battlefield 4, Shadow of Mordor, Crysis 3, Alien: Isolation and The Witcher III: Wild Hunt at their maximum detail settings, in their highest DirectX mode, at several resolutions. High–end cards should be able to sustain playable frame rates at 2,560 x 1,440, while 1,920 x 1,080 is more important for mid–range cards; we also test at 3,840 x 2,160 for 4K monitors, and try to overclock every graphics card we test to assess the performance impact.

The Awards

EXTREME ULTRA
Some products are gloriously over the top. These items of excellent overkill earn our Extreme Ultra award.

PREMIUM GRADE
Premium Grade products are utterly desirable – we'd eat nothing but beans until we could afford them.

PROFESSIONAL
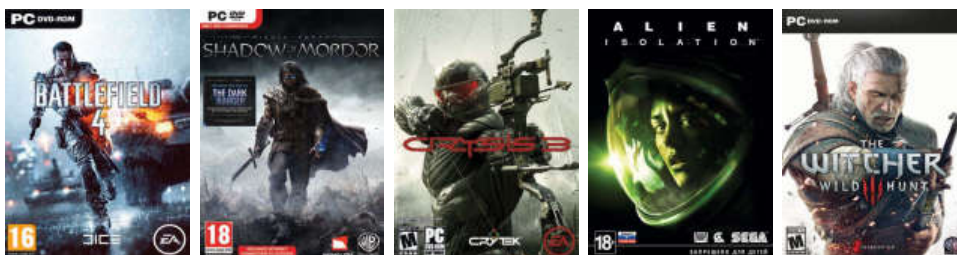Products worthy of the Professional award make you and your business appear even more awesome.

APPROVED
Approved products are those that do a great job for the money; they're the canny purchase for a great PC.

CUSTOM KIT
For those gadgets and gizmos that really impress us, or that we can't live without, there's the Custom Kit award.

Performance without compromise

Trion 960

- Overclocked Intel® Core™ i5-4690K
- ASUS® Z97-P
- 8GB HyperX FURY RAM
- 2GB NVIDIA® GeForce® GTX 960
- 120GB Kingston V300 SSD
- 1TB Hard Drive
- **Windows 8.1**
- 3 Year Standard Warranty

THIS SPEC FROM **£649***

Vanquish HAF III

- Intel® Core™ i5-4590
- ASUS® H81-Gamer
- 8GB HyperX FURY RAM
- 2GB NVIDIA® GeForce® GTX 960
- 120GB Kingston SSD
- 1TB Hard Drive
- **Windows 8.1**
- 3 Year Standard Warranty

THIS SPEC FROM **£749***

Minerva

- Intel® Core™ i5-4690K
- ASUS® RoG MAXIMUS VII RANGER
- 16GB HyperX FURY RAM
- 4GB NVIDIA® GeForce® GTX 970
- 120GB Kingston HyperX 3K SSD
- 2TB Hard Drive
- **Windows 8.1**
- 3 Years Warranty

THIS SPEC FROM **£999***

Ultimate Ti

- Intel® Core™ i7-5930K
- ASUS® Rampage V Extreme
- 32GB HyperX PREDATOR RAM
- 6GB NVIDIA® GeForce™ GTX980Ti
- 6GB NVIDIA® GeForce™ GTX980Ti
- 240GB HyperX SAVAGE SSD
- 1TB Western Digital Black Hard Drive
- **Windows 8.1**
- 3 Years Warranty

THIS SPEC FROM **£2,999***

Optimus Nebula

- Intel® Core™ i7-4720HQ
- 15.6" Matte Full HD ISP LED
- 8GB HyperX IMPACT RAM
- 2GB NVIDIA® GeForce® GTX 960M
- 120GB Kingston HyperX 3K SSD
- 1TB Hard Drive
- **Windows 8.1**
- 3 Year Standard Warranty

THIS SPEC FROM **£849***

Defiance 17

- Intel® Core™ i7-4720HQ
- 17.3" Matte Full HD LED Screen
- 16GB HyperX IMPACT RAM
- 4GB NVIDIA® GeForce® GTX 980M
- 240GB Kingston SSD
- 1TB Hard Drive
- **Windows 8.1**
- 3 Year Standard Warranty

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Custom Kit

Paul Goodhead checks out the latest gadgets, gizmos and geek toys

ACTION CAM
GoPro HERO4 Session / **£330** inc VAT

Being 50 per cent smaller and 40 per cent lighter than GoPro's popular HERO4 Black and Silver cameras, the new Session is so dinky it's positively cute. Square, rather than rectangular, it's designed to be less obtrusive to wear than the other models, whose shape can cause drag.

Sacrifices have been made in the name of slimming, however. Changing settings requires a paired smartphone and the battery isn't replaceable, for example. Image quality also suffers – video from a full-sized HERO4 was noticeably sharper, with greater dynamic

range, and the Session also lacks some of the high-fps settings of its older siblings.

These sacrifices make the Session look more like an entry-level product than its larger sibling, but at £330 inc VAT, it's the same price as the HERO4 Silver. The high price is simply baffling, as in every aspect other than size, the Silver beats the Session.

●●○○○○

**SUPPLIER** www.gopro.com

HARD DRIVE CADDY
Icy Box IB-253U3 / **£10** inc VAT

Whether rescued from a failing laptop or upgraded in favour of an SSD, it's not uncommon to have a spare 2.5in hard disk gathering dust these days and, for £10, Icy Box's toolless 254U3 enclosure is a good way to put that disk to work.

Armed with a speedy USB 3 connection, we saw read/write speeds of 213MB/sec and 110MB/sec respectively with an SSD installed. It looks good too. Milled from textured aluminium, it feels suitably no-nonsense and looks sleek, right up until you coddle it in the horrible, flimsy, off-white rubber jacket that lends the whole unit a slightly childish look. Thankfully, you only lose a modicum of impact protection by tossing the jacket in the bin, leaving a perfectly stylish and affordable USB 3 hard drive chassis.

●●●●○

SUPPLIER www.cclonline.com
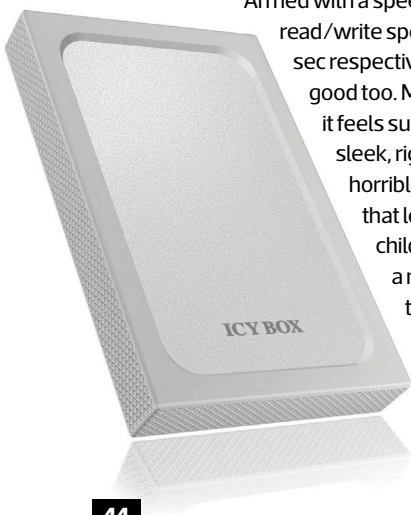
HEADPHONES
AudioQuest NightHawk / **£500** inc VAT

Balanced equitangential airflow, high-excursion drivers, diamond cubic diffusion technology, biocellulose pistonic diaphragms – this is just a sample of the overwrought pseudo-science flung at you by the NightHawk headphones' packaging. The real question is whether they're any good, and the answer is yes.

Comfort is outstanding, thanks largely to the suspension system that keeps the ear cups floating separately from the headband. Audio sounds exciting, with fantastic balance and reproduction that lend impact and clarity. They're as comfortable when delicately pronouncing Einaudi as blasting out Refused. The sting is the high price, but the NightHawk is a great set of headphones.

●●●●○

SUPPLIER www.advancedmp3players.co.uk

BLUETOOTH SPEAKER

1 Fugoo Speaker

Standing out in the Bluetooth speaker market is a tall ask, but Fugoo has done so with its interesting modular approach. Each of the three models (Sport, Style and Tough) is based around the same Core X speaker unit, with the different look and feel of each model provided by the removable cases that are also available to buy separately.

The speaker itself is excellent. Compact and rugged, it's water and dustproof even without a case. Audio is punchy and loud, and while the mix is noticeably biased towards the treble registers, there's still enough bass to prevent output from sounding reedy or unsatisfying. Audio coverage is good too, as the speaker has drivers on every side. The claimed 40 hours battery life is a little too good to be true, but even the 30 hours playback we achieved during testing is still impressive from a unit this size.

2 Fugoo Style /
With speaker **£170** incVAT; Case only **£25** incVAT

The lightest of the three cases, the Style is designed simply to look good and it offers little in the way of extra protection beyond its water-resistant material outer. That's not an issue in everyday use (the speaker is relatively hardy even without a case) but if you're the active type, the Sport and Tough cases offer more impact protection.

Even so, the Style should still have a lot going for it as the cheapest way to access the excellent Core X speaker. However, at the time of going to press, stock of the Style was thin on the ground, pushing up the price and meaning that, at £170, you're better off opting for the Sport model until the prices stabilise.
●●●○○

3 Fugoo Sport /
With speaker **£150** incVAT; Case only **£30** incVAT

The Sport sits in the middle of the Fugoo range, being chunkier and hardier than the Style, but less tank-like than the Tough. It's still comparatively sturdy though – thick rubber coats the bottom and corners of the case, while internal struts make it rigid enough to stand up to drops.

The only area lacking in comparison to the Tough is the large side edges, which are made from flexible, thin plastic grilles rather than rigid metal grilles. Still, at £150, it's currently the cheapest way to get your hands on the excellent Core X speaker, and it's also rugged enough to stand up to all but the most extreme treatment.
●●●●●

4 Fugoo Tough /
With speaker **£190** incVAT; Case only **£70** incVAT

As you'd imagine, the Tough is built to withstand punishment. Made from rugged resin and aluminium, it's the bulkiest and heaviest of the three cases. As such, it's fractionally less portable than its brothers, but the Tough stood up to us standing on it, dropping it from a 6ft height, and it happily took showers with us for a week too.

Annoyingly, it's more difficult to fit or remove than the Sport and Style cases, requiring an Allen key and a number of bolts rather than a single metal clip. At £190 (with speaker), it also commands a £40 premium over the still adequately rugged Sport model, so it's only worth paying the extra cash if you really want your speaker to withstand everything.
●●●●○
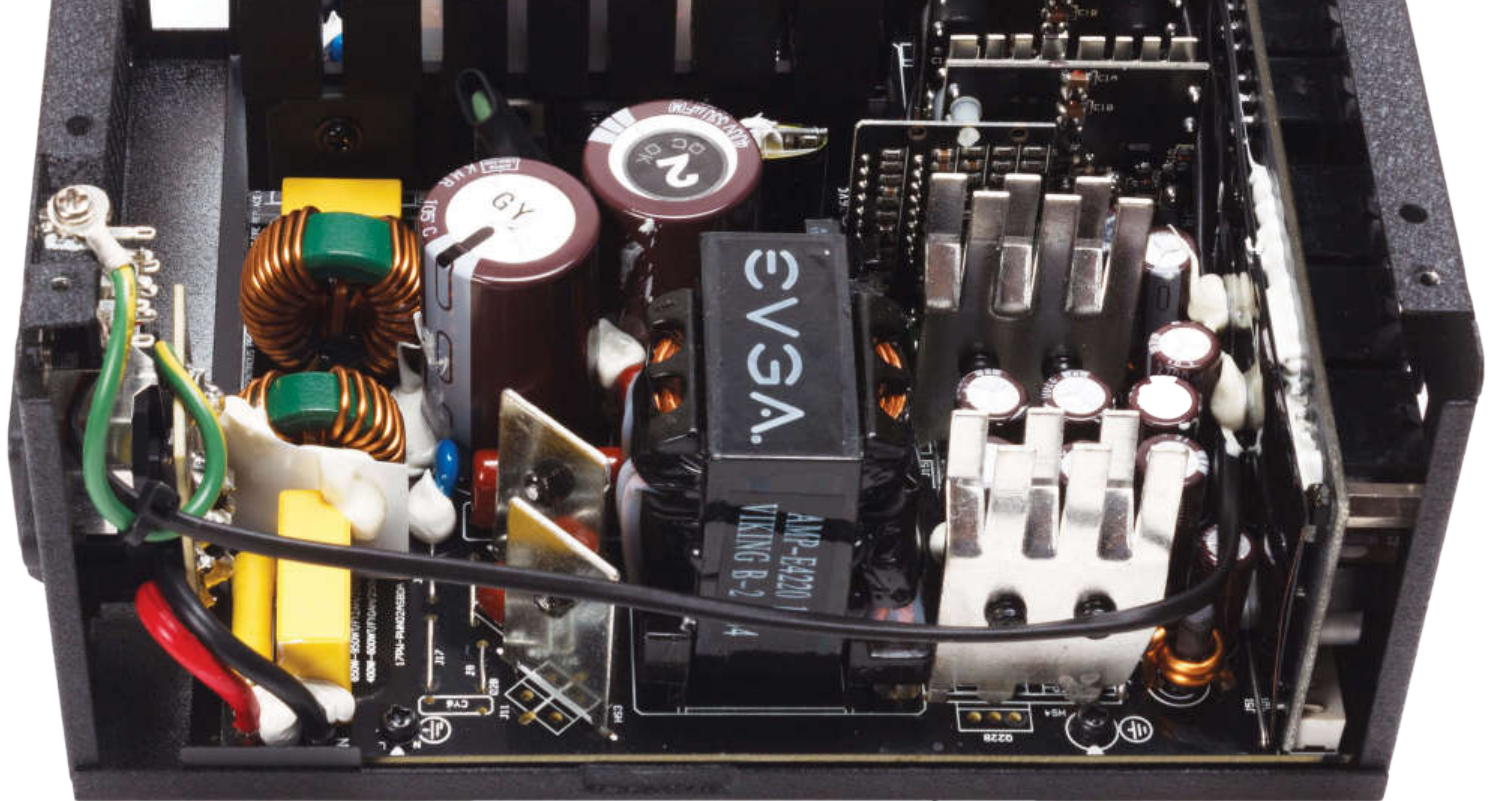
Power struggle

We put 20 top-brand power supplies through a rigorous series of tests to find the ideal partner for your budget and setup

With continuous improvements over the years, not to mention the 80 Plus certification system weeding out the junk, it's tough to find a truly bad branded PSU now. That said, it's still important to stick with tried and tested brands with 80 Plus certification – never be tempted by that unbranded £15 '650W' PSU that looks like a bargain in the shop window – we've consistently seen them die under load in our tests. Your PSU can also have a notable effect on stability if your components aren't getting the required current, and it can affect your PC's overall power consumption and noise levels too.

Of course, overclockers also place higher demands on the PSU, needing as little variation as possible in the voltages delivered to sensitive components, in order to achieve stable results. Thankfully, though, most of the models we tested deliver solid voltages too.

We've tested 20 power supplies from ten different brands. The first batch covers the 500-550W category, providing enough power for a single-GPU PC, while the PSUs in the 750-850W category offer more headroom for power-hungry systems, such as those with multiple GPUs and overclocked LGA2011 CPUs.

DAVID VAN DANTZIG

Featured this issue

How we test

We test power supplies with professional Stratron load generators, which enable us to simulate a load of up to 1,600W on the PSUs in our test lab. We test each PSU in increments of 100W up to the maximum load. At each step, we measure the voltages on the different rails, which need to be as close to the official values of 3.3V, 5V and 12V as possible. A deviation greater than 5 per cent means the PSU doesn't meet the criteria dictated by the ATX specification.

At each step, we also measure the current from the socket with a professional Zes Zimmer ammeter. We can then calculate the efficiency – the percentage of power drawn from the wall socket that's actually delivered to your PC's components. If your components use a total of 400W, a system with an 80 per cent efficient PSU uses 500W (400/0.8), while the same PC with a 90 per cent efficient PSU only draws 444W (400/0.9). This difference can potentially have an impact on your electricity bill, but it can also affect other areas. Any wasted capacity is turned into heat, so more efficient PSUs will stay cooler.

However, the PSU industry has generally made leaps and bounds in efficiency improvements in recent years. The 80 Plus initiative, which provides all PSUs with an efficiency rating (80 Plus, Bronze, Silver, Gold, Platinum and most recently Titanium) has ensured that all the PSUs in this test manage 80 per cent efficiency at the very least, with most models clearing the 84 per cent required to get a Bronze certification.

As such, this aspect carries only a little weight in our final judgement. Instead, areas such as stability, design, features and noise were all given more consideration, while we kept an eye on the price as well. The most expensive PSUs are great, but for many people, a more modest investment will still buy you an excellent product.

Meanwhile, we use an oscilloscope to measure the ripple and noise; fluctuations in the direct current (DC) output of a power supply. If this fluctuation occurs at low frequency then it's known as ripple; at high frequency, it's called noise. It's an arbitrary distinction, and in both cases lower is better, reflecting stability.

Low ripple particularly benefits overclockers wanting to push their system to the limit. The Vtt (voltage-top-top) values indicate the difference between the highest recorded voltages. When the 12V rail has a ripple of 50mVtt, it means it fluctuates between 11.95V and 12.05V. Values around 50mVtt are excellent, ensuring that you don't need to worry, even during extreme overclocking. Values below 75mVtt are still good, but anything far above that level starts to lose points.

In all cases, we draw 50W of current from the 3.3V and 5V rails, and the rest from the 12V rails. This method is different from the one employed by the 80 Plus initiative or most PSU manufacturers, but it's closer to real-world performance. In a PC, all energy-consuming components (mainly the CPU and GPU) only use the 12V rails, and the 3.3V and 5V rails have a very limited role. In addition, we also measure the current drawn from the socket without any load, so we can gauge current leakage.

Finally, so we can gauge noise levels, we test power supplies in a soundproof box, so we can accurately register levels as low as 18dB(A). We measure the sound level at a distance of 10cm from the PSU, with loads of 100W, 300W and 500W.

The 80 Plus initiative, which provides all PSUs with an efficiency rating (80 Plus, Bronze, Silver, Gold, Platinum and Titanium) has ensured that all the PSUs in this test at least manage 80 per cent efficiency

These professional Stratron load generators enable us to simulate a load of up to 1,600W on the PSUs in our test lab

Antec Edge 550W / **£70** inc VAT

SUPPLIER www.scan.co.uk

Antec introduced the Edge series last year, when we concluded that it was a capable power supply but too expensive for the quality on offer. This year, however, the Edge's price has dropped by a tenner, offering much better value for money. All the Edge models include a pair of coloured rubber bands that are designed to prevent noise through vibration, as well as provide some visual flair.

The cables are fully modular, and although they're not all sleeved, they're all more than long enough. However, owners of smaller or older cases should note the Edge's above average size, with a length of 170mm.

Interestingly, the Edge 550W is also one of the few multi-rail designs on test, a concept Antec tenaciously promotes as superior to single-rail setups, despite the obvious convenience of the latter. Either way, the 80 Plus Gold-rated Edge 550W is still a decent performer, averaging 88.6 per cent efficiency

overall. Stability is equally good, with voltages never dropping below 12V. Meanwhile, the ripple result, an area where Antec traditionally excels, is still one of the best from the 500W models test, even if much of the competition has caught up.

In terms of noise production, as long as you don't run the Edge at full load (which is never a

good idea for prolonged periods of time anyway), its illuminated fan runs very quiet at less than 30dB(A). Push it to the max, though, and it becomes quite audible, losing the Edge a few design points.

With a price drop since last year, the Antec Edge 550W is now much more competitive, offering solid voltages and decent efficiency for a reasonable price. The only downer is the noise at full load, and the stiff competition in this bracket.

STABILITY	DESIGN
40/40	30/35

VALUE
21/25

OVERALL SCORE
91%

VERDICT
Noisy at full load, but the Edge offers solid voltages and decent efficiency for a now reasonable price.

Be Quiet! Straight Power 10 500W CM / **£80** inc VAT

SUPPLIER www.ebuyer.com

The Be Quiet! Straight Power E10 is the only model on test rated at 500W, rather than 550W, but that doesn't mean it's cheaper than the 550W units, with the promise of low-noise operation adding up to an £80 inc VAT price tag.

The 160mm long, 80 Plus Gold-rated model sports a large selection of connectors, which are attached to extremely long, fully-sleeved cables. As it's a semi-modular PSU, cable management is also a walk in the park – the only cable that's permanently attached is the 24-pin ATX one, and that makes sense, as you can hardly skip it. Along with the Antec Edge 550W (above), the Straight Power 10 is also one of the few multi-rail designs (with four 12V rails, no less) and Be Quiet! has handily labelled these four 18A rails for your convenience: one rail for the 8-pin CPU connector, one for four Molex and SATA lines, and one per PCI-E graphics line.

Meanwhile, the measured average efficiency of 88.26 per cent is an excellent

result, but it says a lot about the tough competition on offer in this test that this is the second lowest efficiency score. The ripple is also very low and the voltages are rock solid. Efficiency is great at low loads too, measuring 86 per cent at 50W and 90.1 per cent at 100W.

Lastly, the brand honours its name with whisper-quiet operation – the Straight Power 10 is only audible at full load, albeit barely, producing a paltry 35.3dB(A), although this

result is higher than the 28.8dB(A) from the identically priced Corsair RM550. As with the RM550, under normal loads, our equipment couldn't even register the fan's whirring though. The Straight Power 10 CM offers great performance and quiet operation, but it's up against some very stiff competition from Super Flower's Leadex Platinum 550W and Corsair's RM550, which are both even quieter at full load and more efficient on average.

STABILITY	DESIGN
40/40	34/35

VALUE
18/25

OVERALL SCORE
92%

VERDICT
Low-noise operation and great performance, but it's up against stiff competition from Corsair and Super Flower.

Cooler Master V550 / **£75** inc VAT

Cooler Master's V550 might not be fully modular, but you're liable to use all the cables that are permanently attached anyway, and you can attach four more to your liking if needed too. With six SATA and three Molex connectors, it has most drive configurations covered, and the two 6/8-pin PCI-E plugs are par for the course as well.

Meanwhile, cable lengths are all more than satisfactory, and the comparatively shallow depth of 150mm depth means the V550 will easily fit into most cases. All the cables are also fully sleeved, which will make your PC's interior look neater. Most importantly, though, this single-rail contender has an 80 Plus Gold rating and can deliver 45A on its 12V rail.

Performance of this PSU is extremely solid, with a high average efficiency of 89.54 per cent, and also great efficiency under low loads – still a rarity in this test. Even at 22.5W load (where your system is basically doing nothing), it's 82.2 per cent efficient. The 12V voltage is also stable, and ripple values are well within the 'excellent' bracket, maxing out at only 27.2mVtt. Under normal circumstances (up to 300W load), operation is whisper-quiet (although not as quiet as the Be Quiet! Straight Power 10 at 300W load), measuring less than 28dB(A). Stress the V550 it to its limits and noise levels go up, but only to 35.3 dB(A), which is still modest.

The V550 is a solid PSU with low noise levels – our only complaint is the comparatively high asking price of £75 inc VAT, when the £52 EVGA SuperNova GS 550W (see p50) offers similar efficiency and even lower noise levels. Prices can change, though, and the Cooler Master V550 is a cracking PSU if you can find it cheaper.

STABILITY	DESIGN	OVERALL SCORE
40/40	33/35	**89**%
VALUE		
16/25		
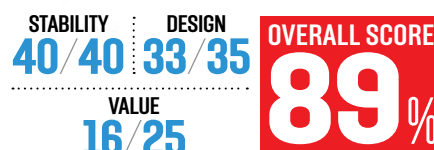
VERDICT
Quiet and efficient, even at low loads, but its price is comparatively high.

Corsair RM550 / **£80** inc VAT

Corsair's RM Series is immensely popular and with good reason, as this 550W model demonstrates. It has a single-rail design, with its 12V rail rated at 46A, and it's also an 80 Plus Gold model. It has a large, quiet fan, plenty of connectors and lengthy, flat cables too. Its length of 160mm puts it in the larger bracket among the other PSUs on test, but it should still fit into plenty of cases.

Where the RM550 really shows its might, though, is in efficiency, with its average of 89.94 per cent being within a whisker of 90 per cent. The Corsair doesn't manage the efficiency of the Cooler Master V550 at extremely low voltages, but from 100W upwards, the difference is negligible, while ripple values across the board are better than those of the V550. The voltage stability is great, and it's whisper-quiet in operation.

Like the Be Quiet! Straight Power 10 500W CM, the noise was too low to measure under normal loads. Our measuring equipment did pick up some noise at full load, but not nearly enough to hear in even a quiet room, and it was even quieter than the aforementioned Be Quiet! PSU at full load as well, although it couldn't match the similarly priced Super Flower Leadex Platinum 550W in this regard. Corsair has received some flak from some online commentators for using non-Japanese capacitors in the RM series, but there's no good reason to suspect future stability problems – a fact that's reinforced by the five-year warranty.

Costing £80 inc VAT, the RM550 isn't cheap, but it's efficient and exceptionally quiet, justifying the extra outlay. Its only problem is that the slightly quieter and more efficient Super Flower Leadex Platinum 550W only costs £3 more, making it the better buy in this price league, but the RM550 remains an excellent PSU.

STABILITY	DESIGN	OVERALL SCORE
40/40	35/35	**95**%
VALUE		
20/25		

VERDICT
Efficient and quiet, the RM550 is an excellent PSU, but the Super Flower Leadex Platinum 550W is (just) the better buy in this league.

Enermax Digifanless 550W / **£179** inc VAT

At a monster price of £179 inc VAT, the Digifanless 550W is easily the most expensive PSU in this category on test, costing more than many models with a much higher power rating. The reason is twofold. Firstly, as its name implies, the Digifanless 550W has no fan; it's completely passively cooled. This makes it a great choice for circumstances where silence is key, such as audio production, but it's overkill for normal use. The second reason is the use of digital circuitry that enables you to adjust the PSU's operation through software, ensuring you have exactly the right voltages and current available for your components.

Enermax also bundles high-quality, individually sleeved cables, which would set you back quite a bit if you bought them separately, helping to compensate for the steep price. Most of the cables are more than long enough too. The PCI-E graphics cables could do with being longer, although four 6/8-pin connectors are provided, along with plenty of other plugs.

The dual-rail Digifanless 550W is also 80 Plus Platinum-rated, and its average of 90.62 per cent makes it the second most efficient PSU on test in this category. Voltage stability and ripple are also very good and, as expected for a fanless model, operation is practically inaudible. It isn't completely silent though; our equipment picked up some electronic noise, most likely coil whine, but you're unlikely to detect it with just your ears – even at full load the total noise was just 23.6dB(A).

The Digifanless 550W is an impressive feat of engineering, but it's also very expensive. If eliminating fan noise is your number one priority, then SilverStone's Nightjar SST-NJ520 520W achieves the same feat with similar efficiency for a much cheaper price, and for everyone else, there are much cheaper actively cooled alternatives that are still very quiet.
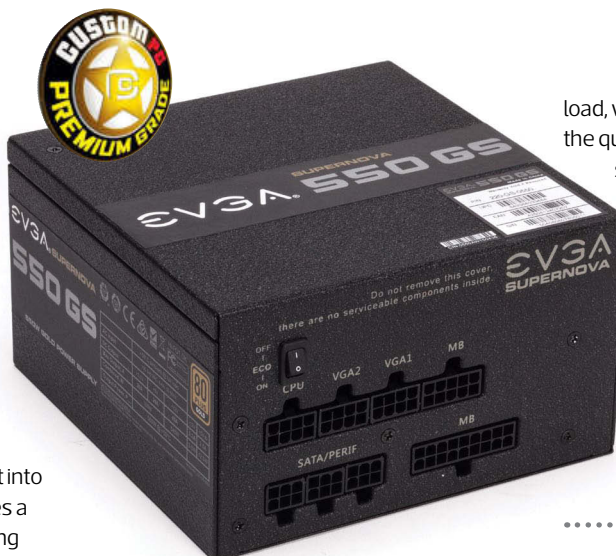
STABILITY	DESIGN
40/40	35/35

VALUE
12/25

OVERALL SCORE
87%
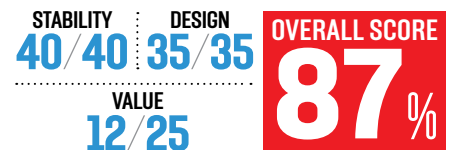
VERDICT
Eliminates fan noise completely, but it's also terribly expensive.

EVGA SuperNova GS 550W / **£52** inc VAT

The EVGA SuperNova GS 550W is the cheapest 80 Plus Gold-rated PSU on test, with a surprisingly low price of just £52 inc VAT, but that doesn't mean EVGA has made any compromises. This fully modular PSU delivers 45A on its single 12V rail and includes plenty of connectors on attractive, long flat cables – including four 6/8-pin PCI-E graphics connectors. With a length of 150mm, it's also compact enough to fit into loads of cases, and EVGA even includes a useful tester to see if the PSU is working without attaching it to a system.

The SuperNova GS' low power efficiency is above average too, while the average efficiency of 89.91 per cent is in line with many pricier units on test. A minor complaint is that the 12V voltage drops just a smidge below 12V at loads of 400W and higher, but it's still well within the ATX specification; we wouldn't even remark on it if it weren't for the fact the competition manages to stay above 12V under all circumstances.

Also, the ripple values we measured are higher than those from the other units on test, but they're still well below 50mVtt and therefore not really worthy of mention. Meanwhile, The 120mm fan is very quiet – you'll struggle to hear it spinning even at full load, where its 28.8dB(A) recording is among the quietest results on test. There's also a semi-passive mode (which EVGA confusingly calls 'Eco' mode), where the fan isn't powered up until a certain temperature threshold has been reached, resulting in even quieter operation.

The EVGA SuperNova GS 550W is a quiet, efficient and capable PSU; it would be easy to recommend at £70, but at £52 inc VAT, it's quite simply a steal.

STABILITY	DESIGN
40/40	33/35

VALUE
25/25

OVERALL SCORE
98%

VERDICT
Quiet, efficient and surprisingly affordable – a steal at this price.

Fractal Design Integra M 550W / £47 inc VAT

SUPPLIER www.cclonline.com

Gold is seemingly the new Bronze when it comes to PSUs, meaning that the sole Bronze-rated PSU in this test is slightly outclassed by the competition. Fractal's Integra M 550W is also cheaper than every other model on test, though, and the difference in efficiency between Bronze and Gold-rated models isn't as high as the classification names imply.

The budget-orientated character of the Integra M is more visible in the number of connectors, which is slightly lower than that of other PSUs on test. Plus, while the Integra M sports flat cables, they're slightly shorter than the wires supplied with the other units on test. All the cables are long enough for any standard-sized system, though, and the 140mm depth makes the Integra M easy to install in almost any enclosure.

As expected, the Integra M isn't as efficient as the other PSUs on test, averaging 83.68 per cent. As such, at 500W load, it consumes 593W rather than the 550-560W consumed by most of the contenders on test. However, the difference is smaller at a more typical 300W load, where the Integra M consumes around 20W more than the others on average. It would take a few years before you could justify the higher price of most of the other models based on efficiency alone.

However, the Integra M also is noisier than much of the competition at full load, and it has the second highest ripple values, even if they're still quite low.

Despite not having Gold certification, most systems would still be well served by the Fractal Design Integra M 550W, and it's worth considering if funds are tight. If you can stretch your budget to an extra fiver, though, the EVGA SuperNova GS 550W is significantly quieter at full load, and more efficient, making it a superior investment.

STABILITY **40**/40 DESIGN **25**/35 VALUE **24**/25

OVERALL SCORE 89%
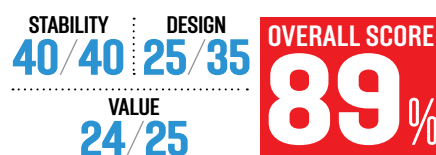
VERDICT
A respectable PSU for the money, but quieter and more efficient PSUs can be had for not much more cash.

Seasonic S12G 550W / £64 inc VAT

SUPPLIER www.scan.co.uk

The Seasonic S12G 550W is the only non-modular PSU on test, but it's an 80 Plus Gold-rated model. It has a single-rail design and plenty of connectors on attractive, long flat cables. Meanwhile, its depth of 140mm makes it easy to install in many cases, and it has a hefty 2kg weight to it, despite its small size.

As that weight suggests, the unassuming size hides a prime internal design and components, as shown by the test results. The average efficiency measured is a decent 89.72 per cent, as is the efficiency under low loads, although the cheaper EVGA SuperNova GS 550W is even more efficient at 100W load. Voltage stability is excellent, with our 12V measurements never coming close to dipping below 12V. The ripple performance is similarly good – it isn't as good as the best on test, but it's still well within specification.

Meanwhile, the 120mm fan operates very quietly, but not inaudibly. Our decibel meters registered just over 30dB(A) at a 10cm distance at a 100W load, meaning you could hear the fan spin in a very quiet room. In practice, we doubt you would hear it though. However, you would definitely hear the fan under full load, as the Seasonic is really quite noisy at full pelt.

Again, the cheaper EVGA is much quieter at full load, although it's never a good idea to run a PSU at full load for long periods of time anyway.

The Seasonic S12G 550W is a decent PSU, but as with many good PSUs today, it's up against seriously tough competition. With captive cabling and a noisy fan at full load, it simply can't justify its asking price when the EVGA SuperNova GS 550W costs £12 less, while offering a modular cabling system and quieter operation.

STABILITY **40**/40 DESIGN **28**/35 VALUE **22**/25

OVERALL SCORE 90%

VERDICT
A decent PSU, but it's let down by its lack of modular cabling and noise at full load.

SilverStone Nightjar SST-NJ520 520W / **£110** inc VAT

The second fully passively cooled PSU in this test comes courtesy of SilverStone. The Nightjar SST-NJ520 has a slightly lower power rating than Enermax's Digifanless 550W, but it also has a much more budget-friendly price tag. Still, £110 inc VAT is still a fair wad of cash, making the Nightjar significantly more expensive than actively cooled models, many of which are still exceptionally quiet. As such, the Nightjar is only worth considering if eliminating fan noise is your priority, perhaps for audio production.

If that's you, though, the Nightjar is definitely the model to get, as our noise level meter didn't move at all during testing, even under high loads.

Looking beyond the pleasant silence that defines this PSU, SilverStone has also equipped it with enough connectors and cable length for any reasonable system, even if the cables are a little shorter than those on offer elsewhere. Meanwhile, the PSU's own length measures 160mm, and while it's a little bigger than the smallest models, it's still more compact than the 175mm Enermax Digifanless 550W.

The Nightjar is one of the three 80 Plus Platinum-rated models in this test and, according to our measurements, it's in fact the most efficient model in this class, at 91.41 per cent average efficiency. Moreover, its voltages are very stable indeed and ripple values are also well within limits, maxing out slightly above 30mVtt.

The Nightjar is a fine PSU, but the premium over the still very quiet, actively cooled competition is significant. This PSU is the best choice if you require absolute silence, and you have a well-ventilated case, but anyone else can save some cash by buying an actively cooled model, many of which are still barely audible at full load.

STABILITY	DESIGN
40/40	35/35

VALUE
15/25

OVERALL SCORE
90%

VERDICT
The best choice if absolute silence is your first requirement, but it demands a premium.

Super Flower Leadex Platinum 550W / **£83** inc VAT

Super Flower has been quietly making a name for itself in the past few years, and the 80 Plus Platinum-rated Leadex Platinum 550W makes it easy to see why. This PSU is only marginally more expensive than the 80 Plus Gold competition, and it delivers excellent performance too.

Before we get to performance, though, let's look at the physical aspects. This 160mm long enclosure is fully modular, and also uses clever universal connectors, so every cable hooks up to the PSU with the same type of plug. The included cables are all flat, and have plenty of connectors too – the total of ten SATA connectors stands out in particular. All the cables are also more than long enough for most people's needs, although the ATX cable could be longer.

The Leadex Platinum 550W features a semi-passive design too, which is activated by a switch at the back. As such, the 135mm fan won't even start spinning unless temperatures demand it.

Meanwhile, the chosen components ensure excellent test results, with a stellar average efficiency of 90.84 per cent. Efficiency at very low loads could be improved, but only slightly – the results are already above average. The 12V line is also rock solid, and ripple values are the lowest we've seen in this class. Add to that the whisper-quiet performance at full load, where it's even quieter than the Corsair RM550 (it's inaudible during normal operation), and it's clear that the Leadex Platinum's slightly higher price is justified. If you're looking for a quiet and highly efficient PSU, and you have the cash, the Super Flower Leadex Platinum 550W is a truly excellent power supply.

STABILITY	DESIGN
40/40	35/35

VALUE
21/25

OVERALL SCORE
96%

VERDICT
Extremely quiet and efficient, while offering the lowest ripple on test. An excellent PSU.

Antec Edge 750W / £91 inc VAT

Like its little brother on p48, Antec's 750W Edge model is 80 Plus Gold-rated and features a dual-rail design; it also sports the colourful rubber bands that help to dampen vibrations. Both rails are individually rated at 40A, but when both are stressed together, the Edge 750W can only deliver a maximum of 62A on the 12V rails in total. With a length of 170mm, the Edge isn't particularly small, but it does have plenty of cables and connectors – the ATX motherboard cable is a little on the short side at 570mm, but the rest of the cables have a respectable length.

The Edge's average efficiency is fine at 89.73 per cent, and although the 88 per cent efficiency measured at very low loads isn't amazing, it's still better than the results from several competitors.

Meanwhile, the 12V rails are very stable, delivering 12.1V even at 700W loads. Antec has a deserved good reputation for its ripple values and the Edge doesn't disappoint, with a maximum measured value of 32.2mVtt. However, the competition has caught up now, with all but one of the competing PSUs on test bettering this result.

It's still a very good result, and well within our 50mVtt parameter that defines great performance, but the competition is doing even better.

The same goes for noise. The Edge isn't overly noisy, with our level meter hitting 34.5 dB(A) at 300W load, and 39.4dB(A) at 500W load, but it's still the least quiet model on test. The main advantage of the Edge is its relatively low price, but even then, the EVGA SuperNova G2 750W is slightly cheaper and quieter. The Antec Edge 750W is a decent PSU, but the tough competition edges it out of the winners' league.

STABILITY	DESIGN	OVERALL SCORE
40/40	32/35	**95%**
VALUE		
23/25		

VERDICT

A decent PSU with a good price, but the tough competition means you can get even better elsewhere.

Be Quiet! Dark Power Pro 11 850W / £160 inc VAT

Be Quiet!'s new Dark Power Pro 11 850W is a veritable powerhouse. Designed in Germany and manufactured to exacting specifications by FSP, it's one of the most expensive models on test, so it needs to deliver the goods. Fortunately, it delivers in spades. The unit is very large, and its length of 195mm means it's not going to fit into smaller cases, and it weighs a hefty 2.4kg too.

However, it's what's inside that counts with a premium PSU. In this case, you get a design with four 12V rails, which can be changed to a single rail function using the included 'OC Key'. Another noteworthy feature is the collection of four fan controllers on the PSU itself; hook up your case fans to these connectors and they automatically become temperature controlled.

Meanwhile, there are plenty of connectors on the included cables, including a huge total of seven PCI-E graphics plugs. All the cables are sleeved and long enough too.

When it comes to performance, the superlatives can continue. The average efficiency of this 80 Plus Platinum PSU is a mind-boggling 91.79 per cent, and it even exceeds 92 per cent at maximum load. If you hate the idea of electricity going to waste, then look no further. Ripple values are also very low, staying below 20mVtt even at maximum load. Meanwhile, the 135mm SilentWings fan stays mostly idle, only spinning up after sustained 500W loads – at which point it's still inaudible, only registering 21.9dB(A) on our meter.

The only downside to this unit is its frankly astronomical price. If you want the best 850W PSU you can buy, and you have the cash then buy this PSU, but you get diminishing returns for your money once you venture into this league. For everyone else, you can get a great PSU for significantly less money elsewhere.

STABILITY	DESIGN	OVERALL SCORE
40/40	35/35	**95%**
VALUE		
20/25		

VERDICT

Mind-bogglingly efficient and very quiet, this is the best 850W PSU we've tested, but the price is ridiculous.

Cooler Master V750 / **£100** inc VAT

As with Cooler Master's V550 (see p54), the V750 comes from the company's V Series semi-modular line-up, which means the CPU, PCI-E graphics and motherboard cables are all fixed to the unit. However, you can add or leave out Molex and SATA cables to your heart's content.

Unlike the smaller model, though, the V750 sports two pairs of PCI-E graphics cables, and you may not need the extra one. On the plus side, you get six Molex and eight SATA connectors, and all the cables are long enough, and are either sleeved or flat. Meanwhile, the single-rail design can deliver 62A on the 12V rail. Interestingly, the enclosure also measures just 140mm in depth, which is quite compact for a PSU of this power rating, and will enable it to be installed in almost any case.

Performance varies from good to great, with the average efficiency of 89.59 per cent being among the best on test, along with the decent efficiency at low loads. However, we found that the 12V supply dips a tiny bit below 12V on loads from 400W and upwards – it's unlikely to ever be an issue, but it's relatively rare behaviour to be seen on a branded PSU these days. This loses it a point on the stability score, as every other PSU on test never dips below 12V.

Ripple, however, turned out to be excellent, topping out at 29.2mVtt, and noise production was also surprisingly low. Even when under duress, our noise level meter only hit 33.8dB(A), which isn't very loud at all. Again, though, similarly priced PSUs such as the Corsair RM750i are even quieter under the same load, and the tough competition is the only problem for the Cooler Master V750. It's a great 750W power supply, but some of the similarly priced competition available is ever so slightly better.

STABILITY	DESIGN
39/40	34/35
VALUE	
24/25	

OVERALL SCORE
97%

VERDICT
Efficient and quiet, with surprisingly low ripple, but the V750 is up against tough competition.

Corsair RM750i / **£103** inc VAT

Corsair's RM Series justifiably won a lot of praise when it entered the market, bringing 80 Plus Gold-rated PSUs to a new price point, and performing well in all departments. One aspect of the range kept haunting the company, though, at least with demanding users: its use of Taiwanese rather than Japanese capacitors, as the latter are perceived as being superior.

Even though no test results or long-term use scenarios have demonstrated any basis for this criticism, this decision seemed to damage the reputation of the RM Series with the high-end crowd. Corsair, ever willing to listen to its users, introduced the RMi Series this year, though, replacing all the capacitors with Japanese-made ones, while introducing digital status monitoring.

Of course, the merits of the former change aren't testable, if they even exist, but the RM750i remains a sterling PSU, with a fully modular design and a single 12V rail that's capable of delivering 62.5A. There are plenty of connectors on the attractive, long flat cables, making installation a breeze. The average efficiency is also very good at 89.47 per cent. Efficiency at very low loads efficiency isn't quite as good, but from 50W and upwards, it's perfectly fine. Ripple values are outstanding too, maxing out at 8.2mVtt.

Meanwhile, the 135mm fan only spins up after prolonged use under load and even then, it's inaudible, with our meter hitting just 23.5dB(A). Bear in mind, though, that this large PSU has a length of 180mm, so make sure you case can accommodate it. The RM750i is a little pricier than its direct competitors, but the exemplary test scores justify the extra cash, even if the changed components perhaps bump up the price unnecessarily. Either way, the RM750i remains an exceptionally quiet PSU that's efficient, well designed and good value for money.

STABILITY	DESIGN
40/40	35/35
VALUE	
24/25	

OVERALL SCORE
99%

VERDICT
Exceptionally quiet, efficient, well designed and good value for money. An excellent PSU if you have the cash.

Enermax Platimax 850W / **£149** inc VAT

SUPPLIER www.pixmania.com

With a price of £149 inc VAT, the Platimax 850W is the second most expensive PSU on test. Interestingly, Enermax uses a quad-rail design, with each 12V rail capable of delivering 30A to components – the total can't exceed 70A, but that's still a very respectable amount of current. With a length of 175mm, it isn't small, though, so you'll need to make sure your case can accommodate it.

Although it's a modular CPU, the motherboard and PCI-E graphics cables are attached by default. You can add three more PCI-E graphics cables for a total of six, as well as cables with eight Molex and eight SATA connectors. All cables are sleeved and just a little shorter than average, with the exception of the Molex and SATA cables, which are plenty long enough

As an 80 Plus Platinum-rated Platimax easily delivers 800W while keeping its 12V line well clear of the ATX specified minimum,

and clear of the 12V border itself. Average efficiency is also an excellent 90 per cent, although efficiency at low loads is disappointing, dipping to 85.2 per cent at 25W. From 100W upwards, it picks up though.

Meanwhile, noise levels are quiet throughout, with barely any difference

recorded between 100W and 500W loads. The measured 33dB(A) is barely audible in a quiet room, and while some models are even quieter, you'll be hard pushed to actually hear the difference.

However, our main quibble with the Platimax 850W is the price of £149 inc VAT.

If you can find it cheaper, it's a great PSU, but at this price, there are better alternatives available for less money.

STABILITY	DESIGN	**OVERALL SCORE**
40/40	34/35	**92**%
VALUE 18/25		

VERDICT
A great PSU, but it struggles to justify its high price.

EVGA SuperNova G2 750W / **£87** inc VAT

SUPPLIER www.dabs.com

EVGA's entrant in this segment is the SuperNova G2 750W, and like EVGA's 550W PSU on test, it comes in at a very tempting price. What's more, the low price of £87 inc VAT doesn't seem to have had any impact on the feature set. It has a fully modular design and a lot of attractive, long, sleeved cables. The cable set includes four PCI-E graphics plugs, which is plenty for a PSU in this class and, remarkably, the SuperNova G2 measures only 140mm long, meaning you can fit it into just about any case.

What's more, the SuperNova G2 750W performs admirably, with an average efficiency of 89.41 per cent and solid 12V stability even at maximum load. The efficiency under low loads is less stellar, but there are no complaints from 100W upwards. The only slight issue with the G2 750W is the ripple, which comes close to our 50mVtt cutoff, recording 47.2mVtt at

maximum load – this won't be an issue in everyday use, but most of the competition has better ripple results.

The SuperNova G2 750W also has the additional benefit of being super-quiet, thanks to its semi-passive 'Eco'-mode. The fan only spins up under prolonged heavy load and, even then, our meter only

registered 32.8dB(A), which is effectively inaudible once you factor in a surrounding case and the distance between the power supply and your ears.

With decent efficiency, a compact enclosure, quiet operation and a very low price, the SuperNova G2 750W is a great deal if your budget (or case) can't accommodate the Corsair RM750i.

STABILITY	DESIGN	**OVERALL SCORE**
40/40	33/35	**98**%
VALUE 25/25		

VERDICT
A compact enclosure, decent efficiency and quiet operation for a surprisingly low price. A great deal.

Fractal Design Edison M 750W / **£89** inc VAT

Swedish brand Fractal Design is represented in this segment by the Edison M 750W, an 80 Plus Gold unit with modular cabling, denoted by the 'M' in the model name. The unit distinguishes itself visually through Fractal's signature white fan, which is visible underneath the grille.

The motherboard, CPU and two PCI-E graphics cables are fixed to the main unit, which makes sense, as most people will always need them. Fractal Design also packs four more PCI-E connectors in the box for a total of six, which is overkill for a 750W PSU, but at least you won't run out of connectors. With the exception of the 24-pin ATX cable, all the cables are flat and have a decent length, although the length isn't as excessive as that offered by some competitors. The unit itself is 160mm long, and its 2.2kg weight makes it one of the heftier PSUs on test too.

The Edison M's test results are solid, with a decent average efficiency of 89.58 per cent, and respectable efficiency from 50W loads onwards. The 12V stability is also good, never dipping below 12V, while the ripple values only max out at 27.6mVtt, a better result than the similarly priced EVGA SuperNova G2 750W. Meanwhile, the 120mm fan runs quietly, being inaudible under lower loads, and only getting marginally louder after being under a 500W load for 20 minutes – the 33.8dB(A) noise measurement is effectively inaudible once the PSU is in a PC case anyway.

The Fractal Design Edison M 750W is a great PSU at a low price. In fact, there's barely any difference in terms of performance and value for money between this PSU and the EVGA SuperNova G2 750W.

As the EVGA has a smaller enclosure, similar efficiency and a slightly lower price, it's our recommended low-price 750W PSU of choice, but there isn't much in it – if you can find the Fractal cheaper then it's still a cracking PSU.

STABILITY	DESIGN	OVERALL SCORE
40/40	32/35	**97**%
VALUE		
25/25		
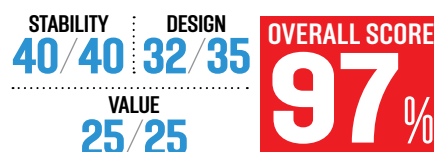
VERDICT
Decent performance and low-noise operation for a great price.

Seasonic Platinum 860W XP2 / **£159** inc VAT

Seasonic's Platinum series has a reputation for excellent quality, so it's no surprise Seasonic charges a premium for the Platinum 860W XP2 at £153 inc VAT.

All the cables, bar the 24-pin ATX cable, are flat, and they all have a decent length too – they aren't the longest on test, but they're long enough. There are plenty of connectors too, including six PCI-E graphics plugs.

Average efficiency is extremely good, with the result of 91.63 per cent being just a smidgen behind the class-leading Be Quiet! Dark Power Pro 11. However, unlike the Be Quiet! unit, the Seasonic's voltages on the 12V line do drop below 12V, starting at loads of 500W. Even though the drop is well within tolerances, we expect better from a premium PSU, especially when it's up against such fierce competition.

Likewise, while the ripple value of 25.4mVtt at maximum load is very good, it's also higher than that of the similarly priced Be Quiet! unit. Noise production, meanwhile, is inaudible regardless of the load, but our meter measured a little noise under low loads, presumably due to coil whine or other electronic sounds, as the fan doesn't spin up under these loads with the Hybrid mode enabled.

Under 500W sustained loads, though, the Be Quiet! PSU made a little more noise than the Seasonic, but the noise levels are so small that the difference is negligible.

The Seasonic Platinum 860W XP2 is a great premium PSU that doesn't disappoint, but you get diminishing returns once you enter this price league, and it's up against fierce competition from the Be Quiet! Dark Power Pro 11. If your case doesn't have room for the Be Quiet! unit, though, and efficiency is your priority, the Seasonic is an excellent, if pricey, power supply.

STABILITY	DESIGN	OVERALL SCORE
40/40	34/35	**94**%
VALUE		
20/25		

VERDICT
A highly efficient PSU that's exceptionally quiet, but it's very expensive.

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SilverStone Strider Gold S 750W / **£96** inc VAT

SUPPLIER www.scan.co.uk

SilverStone's Strider Gold S is reasonably priced at £96 inc VAT, and offers pretty much everything you could want in the features department, including four PCI-E graphics connectors and plenty of SATA and Molex plugs, as well as long, flat cables and a fully modular design. The enclosure is surprisingly small too, measuring just 141mm long, so it will fit in plenty of cases.

All the cables are sufficiently long, and the SATA and Molex cables are very long indeed, with the former measuring over a metre. Meanwhile, the Strider's single 12V rail can deliver 62.5A and it does so with excellent stability and efficiency, averaging 89.77 per cent. Ripple values are also good, with a highest measured value of 23mVtt at maximum load.

What's more, even though the SilverStone Strider Gold S 750W uses a comparatively small 120mm fan, noise production is also excellent. Fan noise is inaudible even after running at a 500W load for 20 minutes, with the meter topping out at 28.5dB(A), putting it among the quieter PSUs on test this month.

SilverStone's only challenge is that the power supply market is now very crowded and, thanks to 80 Plus, fiercely competitive. As a result, there are competing power supplies that manage to be even quieter and deliver even better performance for a similar price. The difference in any real-use scenario is practically non-existent, but you may as well get the best power supply for your budget. That said, the Strider Gold S Series 750W is a great PSU that you should keep on your shortlist if you can find it cheaper, or if your case can't house a larger PSU such as the Corsair RM750i.

STABILITY	DESIGN
40/40	34/35
VALUE	
23/25	

OVERALL SCORE
97%

VERDICT
An all-round solid contender that's quiet, efficient and small enough to fit in most cases.

Super Flower Leadex Platinum 850W / **£123** inc VAT

SUPPLIER www.overclockers.co.uk

The Leadex Platinum 850W boasts 80 Plus Platinum certification for just £123 inc VAT. This PSU has a single-rail design, delivering 70.8A on the 12V rail. It can also run in semi-passive mode by switching the 'Eco'-button on the back. Meanwhile, the many connectors are mounted on flat cables that are more than long enough for any system. Unlike the other 850W models on test, the Super Flower 'only' has four PCI-E graphics connectors, but realistically, you're very unlikely to need more from an 850W PSU anyway.

The Super Flower really shines when it comes to performance though. It manages to deliver some of the best results on test, including the lowest ripple of any 850W class model – a mere 9.8mVtt. Efficiency averages out at 90.08 per cent, which is excellent, even if the pricier Be Quiet! and Seasonic PSUs manage even better efficiency results.

Meanwhile, the 12V supply is rock-solid and noise production is quiet too. In our tests, the fan didn't even spin up until the unit was stressed over a longer period of time with a 500W load.

We measured a noise level of 36.3dB(A) at this load, which is whisper-quiet and probably inaudible once it's inside a case, although competing power supplies such as the Corsair RM750i manage to be even quieter at this load.

The Super Flower Leadex Platinum 850W is a superb PSU, and while it's pricier than a lot of the competition, it's significantly cheaper than other Platinum PSUs, and its ripple results are excellent. If efficiency is your priority, this is a great PSU for the money. As always, though, it's up against very fierce competition from Gold-rated PSUs, and although the differences are small, there are cheaper and quieter PSUs available that are only marginally less efficient.

STABILITY	DESIGN
40/40	34/35
VALUE	
23/25	

OVERALL SCORE
97%
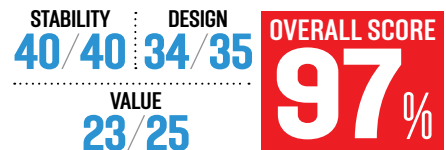
VERDICT
A great price for a Platinum-rated power supply, and with fantastic ripple results, but it's pricey compared with the excellent Gold-rated competition.

FEATURES AND RESULTS

	500-550W						
	ANTEC EDGE 550W	**BE QUIET! STRAIGHT POWER 10 500W**	**COOLER MASTER V550**	**CORSAIR RM550**	**ENERMAX DIGIFANLESS 550W**	**EVGA SUPERNOVA GS 550W**	
Supplier	www.scan.co.uk	www.ebuyer.com	www.argos.co.uk	www.scan.co.uk	www.scan.co.uk	www.dabs.com	
Price inc VAT	£70	£80	£78	£80	£179	£52	
Continuous power	550W	500W	550W	550W	550W	550W	
Certification	80 Plus Gold	80 Plus Gold	80 Plus Gold	80 Plus Gold	80 Plus Platinum	80 Plus Gold	
Modular	Yes	Yes	Yes	Yes	Yes	Yes	
SPECIFIED POWER							
Max current 12V – rail 1	30A	18A	45A	45.8A	30A	45A	
Max current 12V – rail 2	30A	18A			30A		
Max current 12V – rail 3		18A					
Max current 12V – rail 4		18A					
Max current 12V – total	45A	40A	45A	45.8A	45A	45A	
Max current 5V	20A	24A	20A	25A	20A	20A	
Max current 3.3V	20A	24A	20A	25A	20A	20A	
Connectors							
Molex	3	3	3	4	4	4	
Floppy	1	1	1	1	1	1	
SATA	8	9	6	6	8	6	
6-pin PCI-E	–	–	–	–	–	–	
8-pin PCI-E	–	–	–	–	–	–	
6/8-pin PCI-E	2	2	2	2	4	4	
ATX connector	20 / 24 pins	20 / 24 pins	20 / 24 pins	20 / 24 pins	24 pins	20 / 24 pins	
4-pin CPU	Yes	Yes	Yes	Yes	Yes	Yes	
8-pin CPU	1	1	1	1	1	2	
SPECIFICATIONS							
Fan size	135mm	135mm	120mm	135mm	N/A	120mm	
Dynamic fan speed	Yes	Yes	Yes	Yes	–	Yes	
Semi-passive cooling	–	–	–	Yes	–	–	
Mesh around ATX cable	Yes	Yes	Yes	–	Yes	Yes	
Mesh around other cables	–	Yes	Yes	–	Yes	–	
Flat cables	–	–	–	Yes	–	Yes	
Power switch	Yes	Yes	Yes	Yes	Yes	Yes	
Weight	2.26kg	1.74kg	1.21kg	2.05kg	1.9kg	1.6kg	
Length	17cm	16cm	15cm	16cm	17.5cm	15cm	
MEASURED CABLE LENGTHS							
ATX cable	57.5cm	61cm	59cm	64cm	62cm	63cm	
PCI-E cable(s)	68cm	63cm	76cm	77cm	53cm	67cm	
Molex cable(s)	73cm	104cm	73cm	78cm	92cm	89cm	
SATA cables	83.5cm	105.5cm	73cm	72.5cm	95cm	87cm	
CPU power cable	68cm	73cm	65cm	67.5cm	68cm	68.5cm	
TEST RESULTS							
0W Test – PSU off	0.14W	–	0.06W	–	–	0.15W	
0W Test – PSU on	0.22W	0.26W	0.08W	0.13W	0.2W	0.25W	
100W Test – 12V	12.23V	12.14V	12.23V	12.19V	12.03V	12.06V	
100W Test – 12V max ripple	6.2mVtt	11.6mVtt	9.2mVtt	5.2mVtt	22.2mVtt	13.6mVtt	
100W Test – efficiency	89.20%	90.10%	92.90%	91.10%	88.60%	90.90%	
200W Test – 12V	12.21V	12.13V	12.21V	12.18V	12.04V	12.05V	
200W Test – 12V max ripple	11.2mVtt	16.4mVtt	13.2mVtt	8.8mVtt	29.2mVtt	16.6mVtt	
200W Test – efficiency	88.19%	88.60%	90.46%	89.68%	89.85%	89.28%	
300W Test – 12V2	12.19V	12.11V	12.19V	12.14V	12.03V	12.02V	
300W Test – 12V max ripple	14.6mVtt	17mVtt	17.6mVtt	11.6mVtt	24mVtt	23mVtt	
300W Test – efficiency	89.13%	88.78%	89.98%	90.87%	90.62%	90.43%	
400W Test – 12V2	12.17V	12.10V	12.17V	12.12V	12.02V	11.99V	
400W Test – 12V max ripple	18mVtt	20.2mVtt	22.2mVtt	16.6mVtt	24.2mVtt	29.4mVtt	
400W Test – efficiency	89.01%	88.31%	89.33%	90.12%	90.76%	90.43%	
500W Test – 12V2	12.15V	12.08V	12.15V	12.10V	12V	11.96V	
500W Test – 12V max ripple	23.8mVtt	23mVtt	27.2mVtt	22mVtt	24.4mVtt	43.2mVtt	
500W Test – efficiency	88.02%	87.36%	88.40%	89.09%	91.23%	89.51%	
600W Test – 12V							
600W Test – 12V max ripple							
600W Test – efficiency							
700W Test – 12V							
700W Test – 12V max ripple							
700W Test – efficiency							
800W Test – 12V							
800W Test – 12V max ripple							
800W Test – efficiency							
Average efficiency (200W – max load)	88.59%	88.26%	89.54%	89.94%	90.62%	89.91%	
Noise – 100W load – 10cm after 5 minutes.	29.7dB(A)	18dB(A)	27.5dB(A)	18dB(A)	21dB(A)	23.3dB(A)	
Noise – 300W load – 10cm after 5 minutes	29.9dB(A)	18dB(A)	27.8dB(A)	18dB(A)	20.2dB(A)	24.4dB(A)	
Noise – 500W load – 10cm after 20 minutes	53.5dB(A)	35.3dB(A)	35.3dB(A)	28.8dB(A)	23.6dB(A)	28.8dB(A)	

* Prices correct at time of going to press

FRACTAL DESIGN INTEGRA M 550W	SEASONIC S12G 550W	SILVERSTONE NIGHTJAR SST-NJ520 520W	SUPER FLOWER LEADEX PLATINUM 550W	ANTEC EDGE 750W	BE QUIET! DARK POWER PRO 11 850W	COOLER MASTER V750
www.cclonline.com	www.scan.co.uk	www.overclockers.co.uk	www.overclockers.co.uk	www.scan.co.uk	www.novatech.co.uk	www.dabs.com
£47	£64	£110	£83	£91	£160	£100
550W	550W	520W	550W	750W	850W	750W
80 Plus Bronze	80 Plus Gold	80 Plus Platinum	80 Plus Platinum	80 Plus Gold	80 Plus Platinum	80 Plus Gold
Yes	-	Yes	Yes	Yes	Yes	Yes
45.5A	45A	43A	45.8A	40A	30A	62A
				40A	30A	
					35A	
					35A	
45.5A	45A	43A	45.8A	62A	70A	62A
20A	20A	20A	20A	20A	25A	22A
20A	20A	20A	20A	20A	25A	25A
2	3	5	5	6	8	6
-	1	1	1	1	2	1
5	8	6	10	9	8	8
-	-	-	-	-	1	-
-	-	-	-	-	-	-
2	2	2	3	6	6	4
20 / 24 pins	20 / 24 pins	20 / 24 pins	20 / 24 pins	20 / 24 pins	20 / 24 pins	20 / 24 pins
Yes	Yes	Yes	Yes	Yes	Yes	Yes
1	1	1	1	2	2	1
120mm	120mm	N/A	135mm	135mm	135mm	120mm
Yes	Yes	-	Yes	Yes	-	Yes
-	-	-	Yes	-	-	-
Yes	Yes	Yes	Yes	Yes	Yes	Yes
-	-	-	Yes	-	Yes	Yes
Yes	Yes	Yes	Yes	Yes	-	Yes
Yes	Yes	Yes	Yes	Yes	Yes	Yes
1.49kg	2kg	2.28kg	1.62kg	1.8kg	2.4kg	1.77kg
14cm	14cm	16cm	16.5cm	17.2cm	19.5cm	14cm
54cm	57.5cm	63.5cm	57cm	57cm	61cm	59cm
64cm	70.5cm	65.5cm	69cm	66cm	63cm	65cm
55cm	72.5cm	67.5cm	93cm	84.2cm	109cm	73cm
81cm	82.5cm	77.5cm	95cm	74cm	95cm	86cm
74cm	60.5cm	68cm	68cm	67.5cm	73cm	64cm
0.08W	0.12W	-	-	0.15W	0.06W	0.18W
0.18W	0.17W	0.34W	0.22W	0.21W	0.16W	0.24W
12.16V	12.23V	12.19V	12.13V	12.20V	12.09V	12.02V
10.2mVtt	9.4mVtt	14.2mVtt	3.6mVtt	7mVtt	17mVtt	5.4mVtt
83.80%	89.10%	92%	90.80%	88%	89.20%	88%
12.15V	12.22V	12.19V	12.13V	12.19V	12.09V	12.03V
16.6mVtt	13.80mVtt	19mVtt	6.2mVtt	10.6mVtt	19mVtt	18.8mVtt
81.64%	89.42%	90.49%	90.51%	87.86%	89.32%	89.41%
12.13V	12.20V	12.17V	12.11V	12.17V	12.08V	12.01V
22mVtt	18.40mVtt	23.2mVtt	6.8mVtt	14.8mVtt	12.4mVtt	18.8mVtt
84.80%	90.15%	91.72%	91.55%	89.38%	91.61%	89.69%
12.12V	12.18V	12.16V	12.09V	12.15V	12.07V	11.99V
30mVtt	23.80mVtt	26.6mVtt	7.8mVtt	20.2mVtt	11.2mVtt	22mVtt
84.44%	90.15%	91.88%	91.08%	90.28%	91.91%	89.93%
12.10V	12.16V	12.14V	12.06V	12.13V	12.06V	11.98V
38.6mVtt	30mVtt	31.2mVtt	8.4mVtt	24.4mVtt	12.2mVtt	24.6mVtt
83.85%	89.14%	91.53%	90.20%	90.57%	92.35%	89.88%
				12.12V	12.06V	11.96V
				29.2mVtt	13.4mVtt	27mVtt
				90.40%	92.56%	89.51%
				12.10V	12.05V	11.94V
				32.2mVtt	15mVtt	29.2mVtt
				89.86%	92.34%	89.14%
					12.04V	
					16.6mVtt	
					92.42%	
83.68%	89.72%	91.41%	90.84%	89.73%	91.79%	89.59%
32.8dB(A)	31.2dB(A)	18.8dB(A)	18.6dB(A)	29.9dB(A)	18.2dB(A)	25.2dB(A)
33.5dB(A)	31.9dB(A)	19.3dB(A)	19.8dB(A)	34.5dB(A)	18.9dB(A)	26.1dB(A)
54.7dB(A)	58.1dB(A)	19.5dB(A)	26.1dB(A)	39.4dB(A)	21.9dB(A)	33.8dB(A)

FEATURES AND RESULTS

	CORSAIR RM750i	ENERMAX PLATIMAX 850W	EVGA SUPERNOVA G2 750W	FRACTAL DESIGN EDISON M 750W	SEASONIC PLATINUM 860W XP2	SILVERSTONE STRIDER GOLD S 750W	SUPER FLOWER LEADEX PLATINUM 850W
Supplier	www.scan.co.uk	www.pixmania.com	www.dabs.com	www.cclonline.com	www.scan.co.uk	www.scan.co.uk	www.overclockers.co.uk
Price inc VAT	£103	£149	£87	£89	£159	£96	£123
Continuous power	750W	850W	750W	750W	860W	750W	850W
Certification	80 Plus Gold	80 Plus Platinum	80 Plus Gold	80 Plus Gold	80 Plus Platinum	80 Plus Gold	80 Plus Platinum
Modular	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SPECIFIED POWER							
Max current 12V – rail 1	62.5A	30A	62.4A	62A	71A	62.5A	70.8A
Max current 12V – rail 2		30A					
Max current 12V – rail 3		30A					
Max current 12V – rail 4		30A					
Max current 12V – total	62.5A	70A	62.4A	62A	71A	62.5A	70.8A
Max current 5V	25A	24A	24A	20A	25A	22A	20A
Max current 3.3V	25A	24A	24A	20A	25A	22A	20A
Connectors							
Molex	7	8	4	5	5	6	5
Floppy	2	1	1	1	1	2	1
SATA	8	8	9	10	10	8	10
6-pin PCI-E	-	-	-	-	-	-	-
8-pin PCI-E	-	-	-	-	-	-	-
6/8-pin PCI-E	4	6	4	6	6	4	4
ATX connector	20 / 24 pins	20 / 24 pins	24 pins	20 / 24 pins	20 / 24 pins	20 / 24 pins	20 / 24 pins
4-pin CPU	Yes	Yes	Yes	Yes	Yes	Yes	Yes
8-pin CPU	1	1	2	2	1	1	2
SPECIFICATIONS							
Fan size	135mm	139mm	140mm	120mm	120mm	12cm	13.5cm
Dynamic fan speed	Yes	Yes	Yes	Yes	Yes	-	Yes
Semi-passive cooling	Yes	-	Yes	-	Yes	Yes	Yes
Mesh around ATX cable	Yes	Yes	Yes	Yes	Yes	-	Yes
Mesh around other cables	Yes	Yes	Yes	-	-	-	Yes
Flat cables	Yes	-	-	Yes		Yes	Yes
Power switch	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Weight	1.9kg	2.05kg	1.8kg	2.2kg	1.92kg	1.6kg	1.82kg
Length	18cm	17.5cm	18cm	16cm	16cm	14.1cm	16.6cm
MEASURED CABLE LENGTHS							
ATX cable	63cm	58cm	62.5cm	57cm	64cm	58cm	62cm
PCI-E cable(s)	77cm	52.5cm	72.5cm	72cm	69.5cm	73cm	74cm
Molex cable(s)	78cm	91.5cm	88.5cm	69cm	70cm	94cm	93cm
SATA cables	89cm	90cm	80cm	79cm	80cm	110cm	95cm
CPU power cable	68cm	61cm	72.5cm	73cm	69cm	78cm	73cm
TEST RESULTS							
0W Test – PSU off	-	-	-	0.11W	-	0.06W	-
0W Test – PSU on	0.14W	0.17W	0.33W	0.19W	0.26W	0.11W	0.09W
100W Test – 12V	12.07V	12.07V	12.19V	12.12V	12.01V	12.20V	12.22V
100W Test – 12V max ripple	5.2mVtt	41.2mVtt	11.20mVtt	6mVtt	12.6mVtt	11mVtt	3.4mVtt
100W Test – efficiency	88.10%	85.20%	86.70%	87.80%	91%	88.50%	87.40%
200W Test – 12V	12.07V	12.07V	12.19V	12.11V	12.02V	12.19V	12.22V
200W Test – 12V max ripple	5.8mVtt	32.6mVtt	17.2mVtt	7.4mVtt	16.80mVtt	8.2mVtt	4.8mVtt
200W Test – efficiency	88.91%	86.62%	87.95%	88.92%	90.79%	88.95%	89.06%
300W Test – 12V2	12.06V	12.07V	12.18V	12.09V	12.01V	12.17V	12.21V
300W Test – 12V max ripple	6mVtt	24.2mVtt	23.4mVtt	9mVtt	15.8mVtt	10.4mVtt	6mVtt
300W Test – efficiency	89.84%	89.59%	89.47%	89.80%	92.02%	90.60%	89.95%
400W Test – 12V2	12.04V	12.06V	12.16V	12.07V	12V	12.14V	12.20V
400W Test – 12V max ripple	6mVtt	24.6mVtt	30.8mVtt	12.4mVtt	15.6mVtt	12.4mVtt	7.4mVtt
400W Test – efficiency	89.80%	90.19%	90.15%	89.99%	92.12%	90.29%	90.24%
500W Test – 12V2	12.03V	12.05V	12.15V	12.04V	11.99V	12.11V	12.19V
500W Test – 12V max ripple	6.4mVtt	25.8mVtt	36.8mVtt	17.6mVtt	17.6mVtt	14.4mVtt	7.8mVtt
500W Test – efficiency	89.74%	91.17%	89.86%	90.17%	92.10%	89.88%	90.62%
600W Test – 12V	12.02V	12.04V	12.13V	12.02V	11.98V	12.09V	12.18V
600W Test – 12V max ripple	7mVtt	26.8mVtt	44.2mVtt	23.4mVtt	20mVtt	17.6mVtt	8.8mVtt
600W Test – efficiency	89.24%	91.09%	89.86%	89.34%	91.88%	89.79%	90.49%
700W Test – 12V	12.01V	12.04V	12.11V	12V	11.97V	12.06V	12.17V
700W Test – 12V max ripple	8.2mVtt	29.2mVtt	47.2mVtt	27.6mVtt	22.8mVtt	23mVtt	9mVtt
700W Test – efficiency	89.26%	90.87%	89.19%	89.24%	91.61%	89.12%	90.27%
800W Test – 12V		12.03V			11.95V		12.16V
800W Test – 12V max ripple		32.4mVtt			25.4mVtt		9.8mVtt
800W Test – efficiency		90.46%			90.90%		89.93%
Average efficiency (200W – max load)	89.47%	90%	89.41%	89.58%	91.63%	89.77%	90.08%
Noise – 100W load – 10cm after 5 minutes.	18dB(A)	33.1dB(A)	20.1dB(A)	24.4dB(A)	20dB(A)	21.7dB(A)	19.1dB(A)
Noise – 300W load – 10cm after 5 minutes	19.6dB(A)	33.2dB(A)	18.5dB(A)	26.6dB(A)	20dB(A)	24.3dB(A)	19.1dB(A)
Noise – 500W load – 10cm after 20 minutes	23.5dB(A)	33.2dB(A)	32.8dB(A)	33.8dB(A)	20dB(A)	28.5dB(A)	36.3dB(A)

* Prices correct at time of going to press

PC system reviews

GAMING PC

PC Specialist Hailstorm GT / £899 inc VAT

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SUPPLIER www.pcspecialist.co.uk

PC Specialist's Hailstorm GT is notable for two reasons. The first, its £899 price, means it undercuts most of its gaming PC rivals – and the second, found on the inside, is the Skylake processor. The mid-range price means that PC Specialist hasn't opted for a top-tier processor inside the Hailstorm GT. Instead, it's slotted in a Core i5-6600K. The quad-core chip doesn't have Hyper-Threading, which is the biggest difference compared with Core i7 parts, but PC Specialist has given it a serious boost by overclocking it to 4.6GHz.

The use of Skylake means a new motherboard, and in this case, it's an Asus Z170-P. The new chipset means a host of new features: it's the first time we've seen DDR4 memory supported outside of Haswell-E, and there are better options for M.2 SSDs, and more PCI-E 3 lanes across the board.

Elsewhere, the motherboard is pretty basic. It has dedicated audio circuitry and plenty of free headers, but no enthusiast features such as on-board buttons and displays, and its back panel serves up two PS/2 ports, three audio jacks and two USB 2 ports, but only four USB 3 connections – a tad disappointing given that the Z170 chipset supports ten USB 3 ports. Meanwhile, the board's free M.2 connector can fully use the speed on offer from its 4x PCI-E 3 interface, and a single 16x PCI-E slot is vacant, alongside pairs of 1x PCI-E and PCI slots.

As well as the Skylake CPU, the other star of the show is a Zotac Nvidia GeForce GTX 970 card, which runs at stock speed but is a great inclusion at this price, and there's 16GB of 2666MHz DDR4 RAM too. You even get a 240GB Kingston HyperX Fury SSD for your money, and it's partnered with a 2TB hard disk, covering all the fundamental storage bases.

The plastic and metal Corsair Carbide Spec-03 case doesn't look particularly exciting, but you can't expect everything at this price. It looks like the gaming enclosures of old, with dramatic slats, angles and cutaway sections, along with a bulging window in the side panel.

The case has dust filters and a 120mm fan at the front that illuminates the interior with a red LED, but its cable-routing holes aren't routed with rubber. PC Specialist hasn't done the best job with cable tidying either – the bottom of the motherboard, in particular, is a mess of SATA cables. Meanwhile, storage can be added with room for two more 3.5in drives, another 2.5in drive and there's a free 5.25in bay too.

However, most of these bays are currently home to spare cables, which will need to be removed first. Also, the plastic used for the slats and the 5.25in drive bay cover at the front feels flimsy, and the thin metal used for the top panel is similarly weak.

Likewise, the warranty has also been victim to cost cutting. The Hailstorm includes one year of parts and labour coverage, but only the first month is collect and return. After the first year, you then get a further two years of labour-only return to base cover.

Performance

The Hailstorm's overclocked i5-6600K returned a fantastic score of 64,459 in our image editing test – a benchmark that relies on single-threaded speed, and which sees this sub-£1,000 machine even beating the Haswell-E based Overclockers Titan Riptide (see p68). With four cores at its disposal, the Core i5's video encoding score of 258,117 was also very reasonable, particularly considering the price of this machine.

PC Specialist's machine returned an overall score of 119,982, which is an excellent result, making it 4.83 per cent faster than our Devil's Canyon Core i7 reference machine.

The PC Specialist's good form continued in gaming tests, where the Hailstorm's GTX 970 easily beat the R9 380 in the £999 Computer Planet Next Day 4000 i7 Gaming PC

/ SPECIFICATIONS

CPU 3.5GHz Intel Core i5-6600K overclocked to 4.6GHz

Motherboard Asus Z170-P

Memory 16GB Kingston Hyper-X Fury 2666MHz DDR4

Graphics Zotac GeForce GTX 970 4GB

Storage 240GB Kingston HyperX Savage SSD, 2TB Seagate hard disk

Case Corsair Carbide Spec-03

Cooling CPU: Cooler Master Hyper 212 Evo with 1 x 120mm fan; GPU: 1 x 70mm fan; Front: 1 x 120mm fan; rear: 1 x 120mm fan

PSU Corsair CS650M 650W

Ports Front: 2 x USB 3, 2 x audio; Rear: 4 x USB 3, 2 x USB 2, 3 x audio, 1 x Gigabit Ethernet, 2 x PS/2

Operating System Windows 10 Home 64-bit

Warranty One year parts and labour, plus two years labour-only. First month collect and return, followed by return to base coverage

1 There's nothing fancy about the Zotac GTX 970 card, but it delivers the goods in games

2 A quad-core Skylake CPU sits under the heatsink, and is plenty fast enough for gaming

3 Cable tidying could be neater, but that's our only major criticism of this great value PC

(see Issue 144, p60). This £899 PC never dropped below 30fps in any of our game tests, even at 2,560 x 1,440, giving it the edge over the Overclockers Titan Riptide in Crysis 3.

The Hailstorm's storage tests were conclusive, too. The PC Specialist's Kingston SSD returned speeds of 519MB/sec and 429MB/sec in our AS-SSD sequential read and write tests, which are plenty fast enough.

Despite the high overclock, the otherwise mid-range specification meant this PC didn't cause any thermal headaches either. The CPU and GPU delta Ts topped out at 59°C and 60°C respectively, which is fine. We were pleased by the Hailstorm's noise output, too. It was quiet when idle, and the noise only rose slightly during stress testing. Plus, even then, the noise was modest and consistent.

Conclusion

The PC Specialist Hailstorm GT is an £899 gaming tower, which means compromises have to be made to meet the budget. On the plus side, it's great to see a Skylake PC with a GTX 970 for this price, and the performance is superb for the money, particularly in games.

What's more, the new motherboard chipset means there's room to grow as well. On the downside, the cheaper case isn't great, and PC Specialist could have paid better attention to its cable tidying – we expect a better standard from professional PC makers, even at this price, which loses the Hailstorm some design points.

In every other key department, though, the Hailstorm is an excellent PC for the money, prioritising speed over frills. If you're looking for a PC for 2,560 x 1,440 gaming, but have a tight budget, then this machine is a great contender.

MIKE JENNINGS

CPC REALBENCH 2015

GIMP IMAGE EDITING
PC Specialist Hailstorm GT — 64,459
0 | 17,000 | 34,000 | 51,000 | 68,000

HANDBRAKE H.264 VIDEO ENCODING
PC Specialist Hailstorm GT — 25,8117
0 | 65,000 | 130,000 | 195,000 | 260,000

LUXMARK OPENCL
PC Specialist Hailstorm GT — 67,222
0 | 18,000 | 36,000 | 54,000 | 72,000

HEAVY MULTITASKING
PC Specialist Hailstorm GT — 143,910
0 | 40,000 | 80,000 | 120,000 | 160,000

SYSTEM SCORE
PC Specialist Hailstorm GT — 119,982
0 | 30,000 | 60,000 | 90,000 | 120,000

INTEL REFERENCE: 104.83%

BATTLEFIELD 4
1,920 x 1,080, Ultra Detail, 4x AA
PC Specialist Hailstorm GT — 59fps | 72fps
0 | 20 | 40 | 60 | 80

2,560 x 1,440, Ultra Detail, 4x AA
PC Specialist Hailstorm GT — 40fps | 49fps
0 | 13 | 26 | 39 | 52

SHADOW OF MORDOR
1,920 x 1,080, Ultra Detail, FXAA
PC Specialist Hailstorm GT — 55fps | 73fps
0 | 20 | 40 | 60 | 80

2,560 x 1,440, Ultra Detail, FXAA
PC Specialist Hailstorm GT — 40fps | 50fps
0 | 13 | 26 | 39 | 52

CRYSIS 3
1,920 x 1,080, Very High Detail, 0x AA
PC Specialist Hailstorm GT — 46fps | 71fps
0 | 18 | 36 | 54 | 72

2,560 x 1,440, Very High Detail, 0x AA
PC Specialist Hailstorm GT — 31fps | 44fps
0 | 12 | 24 | 36 | 48

Minimum ▪ Average
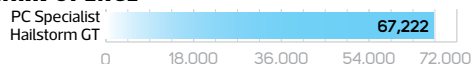
SPEED 21/25

DESIGN 18/25

HARDWARE 21/25

VALUE 21/25

OVERALL SCORE 81%
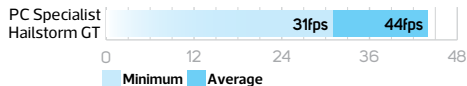
VERDICT

Amazing performance for the money, playing all our test games at 2,560 x 1,440 and even including a Skylake CPU.

GAMING PC

Overclockers Titan Riptide / **1,227** inc VAT

Eschewing Skylake in favour of Haswell-E, Overclockers' Titan Riptide is designed to bridge the gap between games and high-end work applications, and without breaking the bank. The Riptide's work credentials come from the Core i7-5820K, which is the most affordable part from this CPU range, but it still has six Hyper-Threaded cores and a 3.5GHz stock frequency. The former means multi-threaded applications will run quicker than with any current quad-core chip, and Overclockers has also raised the clock speed to 4.2GHz, so it will be fine with single-threaded software and games too.

Meanwhile, the use of Intel's X99 chipset means that the Titan Riptide sports quad-channel DDR4 memory – in this case, a 16GB 2400MHz kit. That isn't the only benefit of the X99 chipset though – it also supports loads of SATA and USB 3 connections, as well as PCI-E M.2 storage. The only slight downer to the i7-5820K is that it only provides 28 PCI-E 3 lanes, rather than the 40 on offer with more expensive Haswell-E chips, but that will only be an issue if you plan to install more than two graphics cards.

All this kit is plugged into an MSI X99A SLI Plus motherboard, which has a dark PCB that fades into the background of the chassis. It has on-board power and reset buttons for easy testing, and it's there's also a vacant, full-sized M.2 connector, loads of free SATA ports and three empty 16x PCI-E slots. Its backplate is well stocked too, with eight USB 3 connectors, optical S/PDIF, five analogue audio jacks and a PS/2 plug for older peripherals. There's also room for four additional memory DIMMs, although one slot is partially blocked by the Alpenföhn CPU cooler.

Graphical power comes from an MSI GeForce GTX 970 card, and MSI has overclocked the GPU from 1,050MHz to 1,102MHz, while the 4GB of GDDR5 memory runs at the standard 7,010MHz (effective) speed. The only slight disappointment in the specs list is the 120GB Samsung 850 Evo SSD. It's fine in terms of speed – it can't match PCI-E M.2 drives, but you're unlikely to notice the difference in most cases. However, its 120GB capacity is soon going to run out once you have a few games installed. Thankfully, the specification is highly customisable, and you can upgrade to a 250GB SSD for an extra £26 inc VAT, which we highly recommend.

The components are all expertly slotted inside a Phanteks Enthoo Pro M chassis. It's dark, sturdy and spacious, and has loads of room to grow. Extra hard disk cages can be slotted into the front, and there's room for optical drives and other 5.25in devices too. More 2.5in SSDs can also be added via a pair of dedicated caddies on the rear of the

motherboard tray, and there's a bracket for water-cooling hardware at the top, plus dust filters in the front, base and roof. Meanwhile, the cooling setup is simple, with an Alpenföhn Matterhorn on top of the processor, two 120mm fans at the front and a single 140mm spinner at the rear.

There's already plenty of room inside the case, and it's only made better by Overclockers' neat build. Most cables are hidden beneath a metal shroud at the bottom, and they're held in place around the back by Phanteks Velcro strips and ties. Cables at the top and bottom of the board are barely visible, and the two GPU power connectors are lashed together with an Overclockers-branded tie.

The Riptide has the standard Overclockers warranty, which gives you two years of collect and return parts and labour coverage, with a further year of return to base labour-only cover. Be warned, though, that the standard specification doesn't include an operating system – we've added it to the price of our review sample, and you'll have to add it yourself at checkout if you don't already have a copy of Windows.

Performance

The overclocked 6-core processor helped the Riptide to deliver a solid slate of benchmark results. Its image editing score of 45,994 shows the single-core pace of the overclocked processor, and the six cores delivered a great score of 367,099 in our heavily multi-threaded video encoding test. The overall system score of 140,640 is fantastic too. However, we've seen slightly better results from similar setups. The Eclipse Excalibur i7582n970-OC (see Issue 145, p64), for example, also had a Core i7-5820K and a GTX 970 but managed an even higher overall score of 151,670, although it did also cost several hundred pounds more than the Titan Riptide.

The Overclockers machine is great in games too, managing playable frame rates in all of our test games at

2,560 x 1,440, and even staying above 60fps in Battlefield 4 and Shadow of Mordor at 1080p. The only borderline title was Crysis 3, which dipped below 30fps at 2,560 x 1,440, but only just, and its 29fps minimum is still well above the 25fps required to be playable.

Meanwhile, the Samsung SSD hit sequential read and write levels of 514MB/sec and 496MB/sec respectively, which are great speeds for a SATA drive – you'd have to step up to the world of PCI-E storage to see quicker results.

We saw no surprises in our thermal tests either. The CPU and GPU returned reasonable delta Es of 63°C and 47°C respectively, and the system never produced more than a low rumble in terms of noise, no matter what task we threw at it. It can be heard in a quiet room, but any noise will easily be crowded out by even modest music or game sounds.

Conclusion

Overclockers aimed to deliver a well-balanced machine that could excel in a wide variety of situations, and we can't question the Riptide's versatility or power. The 6-core processor has been overclocked to provide ample power in single- and multi-threaded situations, and the GPU is capable of gaming at 2,560 x 1,440. There's also loads of memory, a huge 2TB hard disk and room to add more components inside the tidy, versatile case.

Best of all is the price. Even after upgrading the SSD to a 250GB model, the Titan Riptide only costs £1,253 inc VAT. There's no question about the Riptide's credentials – if you're looking for a good value machine that can handle games and multi-threaded workloads, it's an excellent all-rounder.

MIKE JENNINGS

CPC REALBENCH 2015

GIMP IMAGE EDITING

Overclockers Titan Riptide: 45,994

HANDBRAKE H.264 VIDEO ENCODING

Overclockers Titan Riptide: 367,099

LUXMARK OPENCL

Overclockers Titan Riptide: 14,726

HEAVY MULTITASKING

Overclockers Titan Riptide: 146,525

SYSTEM SCORE

Overclockers Titan Riptide: 140640

INTEL REFERENCE: 122.88%

BATTLEFIELD 4

1,920 x 1,080, Ultra Detail, 4x AA
Overclockers Titan Riptide: 65fps / 78fps

2,560 x 1,440, Ultra Detail, 4x AA
Overclockers Titan Riptide: 41fps / 50fps

SHADOW OF MORDOR

1,920 x 1,080, Ultra Detail, FXAA
Overclockers Titan Riptide: 62fps / 84fps

2,560 x 1,440, Ultra Detail, FXAA
Overclockers Titan Riptide: 45fps / 57fps

CRYSIS 3

1,920 x 1,080, Very High Detail, 0x AA
Overclockers Titan Riptide: 46fps / 75fps

2,560 x 1,440, Very High Detail, 0x AA
Overclockers Titan Riptide: 29fps / 41fps

■ Minimum ■ Average

SPEED 22/25
DESIGN 22/25
HARDWARE 22/25
VALUE 22/25

OVERALL SCORE 88%

VERDICT

Fast, well balanced and well built, this is a versatile and great value machine for both gaming and heavily multi-threaded work.

Stealth 2.0 / **£749** inc VAT

Stealth is carving a niche for itself by building PCs with the grunt for gaming in cases that are small and quiet. Its first effort, the Stealth 1.0 (see Issue 142, p60), had reasonable power but uncomfortable audio levels; its second system looks to address those issues.

The Stealth 2.0 doesn't just rely on an APU this time – the machine now pairs one of AMD's mid-range A-series chips with a discrete half-height Gigabyte graphics card based on Nvidia's GeForce GTX 750 Ti. This GPU was the first Maxwell part, so it's very efficient in terms of both temperature and power consumption. In this case, the GPU's original 1020MHz core has been upped to 1033MHz, while its 2GB of GDDR5 memory remains at the stock speed of 5400MHz.

However, Stealth has stuck with the AMD A10-6700 for the second version of its small-form-factor system. It's a quad-core chip (four integer units, but only two floating point units) that runs at 3.7GHz with a Turbo peak of 4.3GHz, but it's based on the Richland architecture from 2013, so it's getting a bit long in the tooth now.

In other departments, you wouldn't know that the Stealth 2.0 is a tiny PC. It has 8GB of DDR3 memory, a 240GB Kingston SSD and a 1TB hard disk, and it's all based on a Gigabyte GA-F2A88XN-WIFI motherboard. This mini-ITX board is well laid-out and includes dual-band 802.11ac Wi-Fi.

All the kit is squeezed into a Thermaltake SD101 chassis, which is many times smaller than an average gaming tower, but it isn't particularly stylish. The Stealth 2.0's components could barely fit inside the case, with some sections of the case bulging. It's also disappointing to see single-channel memory used, rather than dual-channel memory – a setup that can negatively impact performance and saves little money. However, the Thermaltake is functionally an improvement on the Stealth 1.0's chassis, enabling Stealth to keep the cabling marginally neater. It also houses more hardware while not taking up any more space, including the 180W 80 Plus Bronze PSU, which is preferable to the Stealth 1.0's external brick.

Of course, you end up paying a premium for having such a small chassis. As a point of comparison, the PC Specialist Hailstorm GT (see p66) costs £150 more than this machine, but it includes an overclocked Core i5 Skylake processor and a fantastic GTX 970 graphics card, which both trump the Stealth's specification by a significant margin, albeit in a far larger case. Stealth adds value by including a carry case and a keyboard and mouse set, although they're all budget options. The Stealth 2.0 also includes a two-year collect and return warranty.

Performance

The biggest change between the two generations of Stealth machines is the GPU, so it's no surprise that version 2.0 proved far more adept in games. Its Battlefield 4 1080p minimum frame rate of 23fps isn't far away from being playable, and our test is run at Ultra settings, so you'll only need to drop the detail a little to get a playable frame rate.

Its Shadow of Mordor minimum of 37fps was even better – you won't have to tweak any graphics settings to run the game smoothly at top settings. The Stealth 2.0 struggled to a minimum of 18fps in Crysis 3, but that's no surprise – it's our toughest test game. Comparatively, the Stealth 1.0's APU graphics could only manage a playable frame rate in BioShock Infinite once we'd dropped the quality and resolution drastically.

Meanwhile, the Stealth 2.0's application benchmarks are similar to those of the previous machine, as they both share the same processor. The Stealth 2.0 returned an overall score of 48,476, which is only slightly quicker than the first machine. It's enough to handle general computing tasks and it won't bottleneck the GPU in 1080p games, but any tougher applications will strain the chip.

Of course, noise output is an important aspect of a system called the Stealth 2.0, and the situation has improved dramatically since the original machine's consistent racket. The machine is virtually silent when idle or running low-intensity tasks, and a GPU stress test only saw the noise increase a little – the difference was barely detectable. With the processor stress-tested, the noise levels were similarly modest, and with both components running at 100 per cent load, the fan noise was reasonably consistent and low.

The Stealth is quieter than the average desktop gaming PC and, if you're taking it to LAN parties or playing with speakers and headphones, you just won't notice its fans – the room will have to be silent before it becomes irritating.

Our stress testing didn't cause any thermal issues either, despite the case's tight confines. The highest temperature came from the GPU, but its peak delta E of 62˚C isn't a cause for concern.

Meanwhile, the Kingston SSD returned a decent sequential read score of 485MB/sec, but faltered with a write speed of 162MB/sec. It isn't the fastest SSD, but it's still much faster than the lone hard drive in the Stealth 1.0.

Conclusion

Stealth's second crack at a small, quiet gaming PC doesn't look like much from the outside, but it's an improvement in several areas. The AMD processor is a little long in the tooth now, but it has enough power to handle the tasks that will be required from this system, and the addition of a discrete graphics card adds gaming abilities that Stealth's first PC sorely lacked. The inclusion of an SSD is very welcome too.

Crucially, Stealth has also managed to cut the noise down. This system is quieter than the vast majority of gaming systems, and you won't notice its noise output if you're at a LAN event. The Stealth 2.0 is very small and quiet, but still significantly more powerful than your average NUC machine, even if it's not quite as small. For this reason, we've based the scores below on mini machines, rather than comparing it directly with full-sized desktops. After all, the Stealth 2.0 only measures 119mm across.

However, the choice of an APU is questionable once you add a discrete GPU. The main benefit of an APU is the integrated GPU, as Intel's CPU cores are otherwise significantly quicker, and Stealth has missed a trick here.

The other question is the price, as you'll get significantly more power from a traditional desktop PC for similar money. However, if you're looking for the smallest possible PC that can handle games at half-decent settings, while not making a racket, the Stealth 2.0 is surprisingly capable.

MIKE JENNINGS

CPC REALBENCH 2015

GIMP IMAGE EDITING

Stealth 2.0 — 29,756

0 | 8,000 | 16,000 | 24,000 | 32,000

HANDBRAKE H.264 VIDEO ENCODING

Stealth 2.0 — 98,367

0 | 25,000 | 50,000 | 75,000 | 100,000

LUXMARK OPENCL

Stealth 2.0 — 34,412

0 | 10,000 | 20,000 | 30,000 | 40,000

HEAVY MULTITASKING

Stealth 2.0 — 58,901

0 | 15,000 | 30,000 | 45,000 | 60,000

SYSTEM SCORE

Stealth 2.0 — 48,476

0 | 13,000 | 26,000 | 39,000 | 52,000

AMD REFERENCE: 85.79%

BATTLEFIELD 4
1,920 x 1,080, Ultra Detail, 4x AA

Stealth 2.0 — 23fps 28fps

0 | 7 | 14 | 21 | 28

SHADOW OF MORDOR
1,920 x 1,080, Ultra Detail, FXAA

Stealth 2.0 — 37fps 50fps

0 | 13 | 26 | 39 | 52

CRYSIS 3
1,920 x 1,080, Very High Detail, 0x AA

Stealth 2.0 — 18fps 27fps

0 | 7 | 14 | 21 | 28

Minimum ■ Average

SPEED	DESIGN
23/25	19/25
HARDWARE	VALUE
20/25	17/25

OVERALL SCORE
79%
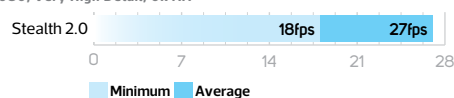
VERDICT

An exceptionally small gaming PC that can still churn out half-decent frame rates without making a racket, although it isn't cheap for the power on offer.

Elite

....

Our choice of the best hardware available

Build a mini APU PC

The parts you'll need to build an affordable, general-purpose mini PC that's ideal for putting in the lounge, based on an AMD APU. This machine will handle general computing and media tasks with no trouble, as well as basic gaming, although you'll have to lower the detail settings.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	SilverStone Fortress FTZ01	www.scan.co.uk	Issue 144, p84	£110
	Gigabyte F2A88XN-WiFi	www.cclonline.com	Issue 144, p84	£81
	AMD A10-7870K	www.ebuyer.com	Issue 144, p22	£106
	8GB Corsair Vengeance Pro 2400MHz (CMY8GX3M2A2400C11R)	www.scan.co.uk	Issue 144, p84	£40
	Cooler Master Seidon 120V	www.scan.co.uk	Issue 144, p84	£39
	250GB Crucial BX100	www.scan.co.uk	Issue 144, p84	£66
	SilverStone SST-ST30SF	www.scan.co.uk	Issue 144, p84	£41
	Microsoft Windows 10 Home Retail USB drive **UPDATED**	www.scan.co.uk	Issue 146, p17	£88
			TOTAL	**£571**
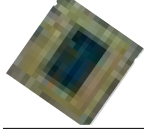
Build a budget gaming PC

The parts you'll need to build a budget machine capable of playing the latest games at maximum settings on a 1080p monitor. The machine has a discrete graphics card, a highly overclockable dual-core CPU and high-speed memory. Meanwhile, the Z97 motherboard gives you headroom to upgrade to a faster CPU later.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	NZXT S340	www.overclockers.co.uk	Issue 137, p54	£60
	ASRock Z97 Pro3	www.scan.co.uk	Issue 130, p50	£68
	Intel Pentium G3258	www.scan.co.uk	Issue 132, p17	£52
	8GB Corsair Vengeance Pro 2400MHz DDR3 (CMY8GX3M2A2400C11R)	www.scan.co.uk	Issue 132, p22	£40
	Asus Radeon R9 380 Strix Gaming DirectCU II OC 2GB	www.scan.co.uk	Issue 145, p27	£179
	250GB Crucial BX100	www.scan.co.uk	Issue 144, p84	£66
	SilverStone Argon AR01	www.scan.co.uk	Issue 132, p57	£26
	EVGA SuperNova GS 550W **UPDATED**	www.dabs.com	Issue 146, p50	£52
	Seagate Barracuda 2TB ST2000DM001	www.scan.co.uk	Issue 104, p75	£54
	Microsoft Windows 10 Home Retail USB drive **UPDATED**	www.scan.co.uk	Issue 146, p17	£88
			TOTAL	**£685**

Build a mid-range PC

Work PC

The parts you'll need to build a solid quad-core PC with plenty of upgrade potential. This kit list gives you an all-in-one liquid cooler and a K-series Core i5 Skylake CPU, meaning you can overclock it and get some serious processing power. We've managed to get the Core i5-6600K Skylake CPU up to 4.6GHz, so it has some great performance potential. Also included is a solid EVGA PSU, a 500GB SSD and 8GB of high-speed DDR4 memory. The core configuration assumes you won't be doing any serious gaming, however, and it relies on Intel's integrated graphics.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	NZXT Phantom 530	www.overclockers.co.uk	Issue 127, p44	£98
	MSI Z170A Gaming M5 **UPDATED**	www.ebuyer.com	Issue 146, p20	£150
	Intel Core i5-6600K **UPDATED**	www.scan.co.uk	Issue 145, p17	£199
	8GB Corsair Vengeance LLPX 2666MHz DDR4 (CMK8GX4M2A2666C16) **UPDATED**	www.scan.co.uk	Issue 145, p24	£54
	NZXT Kraken X41	www.overclockers.co.uk	Issue 138, p57	£70
	EVGA SuperNova GS 550W **UPDATED**	www.dabs.com	Issue 146, p50	£52
	Seagate Barracuda 2TB ST2000DM001	www.scan.co.uk	Issue 104, p75	£54
	Lite-On IHAS124-14	www.dabs.com	Issue 99, p108	£10
	Crucial BX100 500GB	www.ebuyer.com	Issue 141, p43	£135
	Microsoft Windows 10 Home Retail USB drive **UPDATED**	www.scan.co.uk	Issue 146, p17	£88
			TOTAL	**£910**

Gaming PC

The graphics card you'll need to play current games at their maximum settings at 1080p and 2,560 x 1,440.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	1,920 x 1,080 Asus Radeon R9 380 Strix Gaming DirectCU II OC 2GB	www.scan.co.uk	Issue 145, p27	£179
	2,560 x 1,440 Nvidia GeForce GTX 970 4GB	www.scan.co.uk	Issue 140, p48	£248

Build a performance PC

Work PC

The parts you'll need to build a high-quality, fast PC that's ideal for multi-threaded workloads. This kit list features a high-quality, well-built case, a feature-rich motherboard and an Intel Skylake Core i7-6700K CPU. This processor's support for Hyper-Threading splits the resources of the CPU's four physical cores into a further four virtual cores, meaning it can effectively handle eight threads at once. There's also a solid Corsair 750W PSU, giving you plenty of headroom for overclocking and adding another GPU, 16GB of DDR4 memory and an all-in-one liquid cooler.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	Cooler Master Cosmos SE	www.cclonline.com	Issue 144, p41	£125
	Asus Maximus VIII Hero **UPDATED**	www.novatech.co.uk	Issue 146, p20	£173
	Intel Core i7-6700K	www.scan.co.uk	Issue 145, p17	£354
	16GB Corsair Vengeance LLPX 2666MHz DDR4 (CMK16GX4M2A2666C16)	www.scan.co.uk	Issue 145, p24	£102
	NZXT Kraken X41	www.overclockers.co.uk	Issue 138, p57	£70
	Corsair RM750i **UPDATED**	www.scan.co.uk	Issue 146, p55	£103
	Seagate Barracuda 2TB ST2000DM001	www.scan.co.uk	Issue 104, p75	£54
	Samsung 850 Evo 500GB	www.scan.co.uk	Issue 141, p51	£144
	Microsoft Windows 10 Home Retail USB drive **UPDATED**	www.scan.co.uk	Issue 146, p17	£88
			TOTAL	**£1,213**

Gaming PC

The graphics card you'll need to play current games at their maximum settings at 2,560 x 1,440 and beyond.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	2,560 x 1,440 Nvidia GeForce GTX 970 4GB	www.scan.co.uk	Issue 140, p48	£248
	4K 2 x Nvidia GeForce GTX 970 4GB	www.scan.co.uk	Issue 140, p50	£496

Build a 6-core workstation

Multi-threaded workstation

The parts you'll need to build a PC with serious power in multi-threaded workstation software, such as 3D rendering apps and optimised distributed computing software. The kit list features a 6-core LGA2011-v3 CPU, which is overclockable using the motherboard and cooler listed. Also supplied is 16GB of RAM, 1TB of solid state storage and a 1.2kW PSU, providing loads of headroom for adding multiple GPUs.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	Phanteks Enthoo Luxe	www.eclipsecomputers.com	Issue 144, p53	£117
	Asus X99 Deluxe	www.overclockers.co.uk	Issue 136, p20	£300
	Intel Core i7-5820K	www.scan.co.uk	Issue 134, p43	£306
	Asus Radeon R9 380 Strix Gaming DirectCU II OC 2GB	www.scan.co.uk	Issue 145, p27	£179
	16GB Corsair Vengeance LPX 2666MHz DDR4 (CMK16GX4M4A2666C16)	www.scan.co.uk	Issue 136, p14	£114
	Corsair Hydro H110i GT	www.eclipsecomputers.com	Issue 140, p17	£95
	Corsair Professional Series AX1200i	www.scan.co.uk	Issue 111, p40	£253
	Samsung 850 Evo 1TB	www.cclonline.com	Issue 141, p51	£281
	Seagate Barracuda 2TB ST2000DM0001	www.scan.co.uk	Issue 104, p75	£54
	Lite-On IHAS124-14	www.dabs.com	Issue 99, p108	£10
	Microsoft Windows 10 Home Retail USB drive **UPDATED**	www.scan.co.uk	Issue 146, p17	£88
			TOTAL	**£1,797**

4K gaming PC

This LGA2011-v3 system can support multiple graphics cards over 28 PCI-E 3 lanes, making it an ideal foundation for high-resolution PC gaming, replacing the graphics card listed above with two high-spec cards.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	4K 2 x Nvidia GeForce GTX 970 4GB	www.scan.co.uk	Issue 140, p50	£496
			TOTAL	**£2,114**
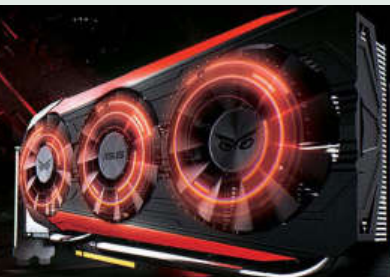
Build a mini PC

Core components

The parts you'll need to build either PC. This kit list gives you a solid PSU, 8GB of RAM, an overclockable Haswell CPU, an all-in-one liquid cooler and Windows 7 Home Premium. Also included is a short-PCB graphics card that can play current games at their maximum settings at 2,560 x 1,440, and a 500GB SSD.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	Intel Core i5-4690K	www.scan.co.uk	Issue 132, p18	£186
	8GB Corsair Vengeance Pro Series 2400MHz DDR3	www.scan.co.uk	Issue 132, p22	£40
	Corsair H75	www.scan.co.uk	Issue 138, p46	£63
	Asus GeForce GTX 970 DirectCU Mini	www.overclockers.co.uk	Issue 139, p20	£300
	Crucial BX100 500GB	www.ebuyer.com	Issue 141, p43	£135
	Seagate Barracuda 2TB ST2000DM001	www.scan.co.uk	Issue 104, p75	£54
	Lite-On IHAS124-14	www.dabs.com	Issue 99, p108	£10
	EVGA SuperNova GS 550W	www.dabs.com	Issue 146, p50	£52
	Microsoft Windows 10 Home Retail USB drive **UPDATED**	www.scan.co.uk	Issue 146, p17	£88

Mini-ITX PC

The parts you'll need to build a pint-sized powerhouse.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	Corsair Obsidian 250D	www.scan.co.uk	Issue 136, p41	£75
	Asus Maximus VII Impact	www.overclockers.co.uk	Issue 136, p52	£183
			TOTAL	**£1,186**

Micro-ATX PC

The parts you'll need to build a mini PC that doesn't take up as much room as a full-sized desktop.

	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	Fractal Design Arc Mini R2	www.scan.co.uk	Issue 127, p46	£67
	Asus Maximus VII Gene	www.overclockers.co.uk	Issue 133, p18	£160
			TOTAL	**£1,155**

Cases

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	Budget ATX	NZXT S340	www.overclockers.co.uk	Issue 137, p54	£60
	Sub-£100 ATX quiet	Fractal Design Define R5	www.scan.co.uk	Issue 137, p20	£80
	Sub-£100 ATX performance	NZXT Phantom 530	www.overclockers.co.uk	Issue 127, p44	£98
	Sub-£150 full-sized ATX quiet	Nanoxia Deep Silence 5	www.quietpc.com	Issue 144, p50	£113
	Sub-£150 full-sized ATX	Phanteks Enthoo Luxe	www.eclipsecomputers.com	Issue 144, p53	£117
	Sub-£150 mid-size ATX	Cooler Master Cosmos SE	www.cclonline.com	Issue 144, p41	£125
	Mini-ITX tower	Corsair Obsidian 250D	www.scan.co.uk	Issue 136, p41	£75
	Mini-ITX cube	Antec ISK600	www.overclockers.co.uk	Issue 126, p28	£45
	Micro-ATX	Fractal Design Arc Mini R2	www.scan.co.uk	Issue 127, p46	£67
	Water-cooling micro-ATX	Parvum Systems S2.0	www.overclockers.co.uk	Issue 129, p22	£140

Graphics cards

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	1,920 x 1,080 gaming	Asus Radeon R9 380 Strix Gaming DirectCU II OC 2GB	www.scan.co.uk	Issue 145, p27	£179
	2,560 x 1,440 gaming	Nvidia GeForce GTX 970 4GB	www.scan.co.uk	Issue 140, p48	£248
	High-end single-GPU gaming	Nvidia GeForce GTX 980 Ti	www.scan.co.uk	Issue 143, p20	£523
	4K gaming	2 x Nvidia GeForce GTX 970 4GB	www.scan.co.uk	Issue 140, p49	£496
	Mini-ITX	Asus GeForce GTX 970 DirectCU Mini	www.overclockers.co.uk	Issue 139, p20	£300

Power supplies

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	Mid-range 550W	EVGA SuperNova GS 550W **UPDATED**	www.dabs.com	Issue 146, p50	£52
	High-end 550W	Super Flower Leadex Platinum 550W **UPDATED**	www.overclockers.co.uk	Issue 146, p52	£83
	Mid-range 750W	Corsair RM750i **UPDATED**	www.scan.co.uk	Issue 146, p55	£103
	High-end 1.2kW	Corsair Professional Series AX1200i	www.scan.co.uk	Issue 111, p40	£253

Networking

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	Router	Asus RT-AC68U	www.scan.co.uk	Issue 128, p88	£130
	Wi-Fi adaptor	Asus PCE-AC68	www.scan.co.uk	Issue 128, p88	£67

Storage

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	Hard disk	Seagate Barracuda 2TB ST2000DM001	www.scan.co.uk	Issue 104, p75	£54
	250GB SSD	Crucial BX100 250GB	www.scan.co.uk	Issue 141, p43	£66
	500GB SSD	Crucial BX100 500GB	www.ebuyer.com	Issue 141, p43	£135
	1TB SSD	Samsung 850 Evo 1TB	www.cclonline.com	Issue 141, p51	£281
	High-performance SSD	Intel SSD 750 1.2TB	www.scan.co.uk	Issue 143, p24	£809
	NAS box	Synology DS215J	www.cclonline.com	Issue 138, p17	£134

Monitors

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	24in monitor	Dell U2414H	www.overclockers.co.uk	Issue 129, p43	£200
	29in monitor	Asus PB298Q	www.scan.co.uk	Issue 129, p52	£293
	28in 4K monitor	Asus PB287Q	www.scan.co.uk	Issue 133, p44	£382
	G-Sync monitor	Asus ROG Swift PG278Q	www.eclipsecomputers.com	Issue 143, p44	£600
	FreeSync monitor	BenQ XL2730Z	www.overclockers.co.uk	Issue 143, p46	£440

Peripherals

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	Budget mechanical keyboard	Gigabyte Aivia Osmium	www.awd-it.co.uk	Issue 139, p40	£72
	Mechanical gaming keyboard	CM Storm Trigger-Z	www.ebuyer.com	Issue 139, p44	£79
	Mechanical MMO keyboard	Corsair Vengeance K95	www.awd-it.co.uk	Issue 123, p64	£125
	Gaming mouse	Logitech G402 Hyperion Fury	www.currys.co.uk	Issue 139, p53	£40
	Wireless gaming mouse	SteelSeries Sensei Wireless	www.box.co.uk	Issue 139, p61	£90
	Flight stick	Saitek X-55 Rhino H.O.T.A.S.	www.overclockers.co.uk	Issue 131, p29	£170
	Steering wheel and pedals	Thrustmaster TX Ferrari 458 Italia Edition	www.overclockers.co.uk	Issue 137, p32	£300

Audio

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	PCI-E sound card	Creative Sound Blaster Z	www.eclipsecomputers.com	Issue 116, p42	£66
	USB DAC	Asus Xonar Essence One	www.overclockers.co.uk	Issue 118, p44	£363
	2.1 speakers	Acoustic Energy Aego M	www.amazon.co.uk	Issue 142, p52	£165
	Soundbar	Razer Leviathan	www.overclockers.co.uk	Issue 142, p57	£165
	Headset	HyperX Cloud II	www.ebuyer.com	Issue 142, p46	£70
	Surround-sound headset	Asus Strix 7.1	www.cclonline.com	Issue 142, p43	£150

Systems

	TYPE	NAME	SUPPLIER	FEATURED	PRICE (inc VAT)
	Sub-£1,000 gaming PC	PC Specialist Hailstorm GT **UPDATED**	www.pcspecialist.co.uk	Issue 146, p66	£899
	Quiet gaming PC	Chillblast Fusion Serenity	www.chillblast.co.uk	Issue 138, p66	c. £1,499
	Dream PC	Scan 3XS Barracuda	www.scan.co.uk	Issue 145, p58	c.£9,499
	Sub-£2,000 gaming PC	Scan 3XS X99 Carbon Ti	www.scan.co.uk	Issue 143, p58	c.£1,999
	Skylake PC	Scan 3XS Z170 Vengeance	www.scan.co.uk	Issue 145, p66	c. £1,449
	Mini-ITX PC	PC Specialist Nemesis Evo	www.pcspecialist.co.uk	Issue 144, p58	c. £1,599
	Gaming laptop	MSI GT70 2PC Dominator	www.overclockers.co.uk	Issue 129, p26	c. £1,320
	Premium PC	Overclockers UK Infin8 Emperor	www.overclockers.co.uk	Issue 145, p44	c.£5,399

Games

RICK LANE / INVERSE LOOK

CRUNCH CORNER

Game development companies use their employees' passion to exploit them, and their methods are becoming more insidious, says Rick Lane

I recently researched Lionhead's fascinating 2001 god game Black & White, and in the process, stumbled upon a development analysis by Peter Molyneux written after its release. In the article, Molyneux details development of the game's visuals, artificial intelligence, story and so on. But there was one paragraph that stood out to me:

'The last few months of the project were the hardest any of us has ever had to work, but thanks to the people, they were also some of the most fun months we ever had. If nothing else, we'll always remember the time we spent closeted together making Black & White.'

From an enthusiastic auteur such as Molyneux, these words evoke a passionate team coming together at the final hurdle to create something special. Step back, however, and it's apparent that (regardless of intent) Molyneux is referring to an insidious phenomenon in the game industry – one that, 15 years later, still plagues studios worldwide.

That phenomenon is crunch; dev teams working intense and protracted overtime to meet deadlines. During crunch, a designer's working week can balloon from the usual 40 hours to 70, 80 or even 100 hours a week. And because developer jobs are usually salaried, those trapped in the vice see little if any remuneration for the extra work.

It's not unusual for employees to work extra hours in the days before a company project reaches its conclusion but, as noted by Molyneux, game development crunch can extend over months, and occur at any time during development, rather than near the end. Indeed, crunch has become so prevalent in the game industry that it's now considered a normal aspect of development, rather than a last resort. Since developers don't

always pay salaried employees overtime, crunch can also be the cheapest way to complete a project on time.

A big problem is that crunch is seen as indicative of a developer's passion. You're making games, and games are fun whether you're a creative director or cleaning the studio's toilets, so being offered a job in the game industry is viewed as a privilege, rather than a fair exchange of money for skills.

Also, despite the industry being decades old, the average developer's age is almost unchanged as hordes of young talent arrive, burn out and are replaced. As one developer told The Guardian: 'I think we still sort of perversely like this maverick sensibility around our jobs that makes us sort of figures of martyrdom in the name of art.'

Various attempts have been made to tackle crunch. In 2004, Erin Hoffman published a blog called EA Spouse, describing her husband's experiences crunching for EA, which led to several lawsuits. Meanwhile, organisations such as the Independent Game Developers Association liaise with trade bodies in the UK and US in an attempt to reduce the problem.

Since 2004 the situation seems to have improved, but only slightly – with 19 per cent of respondents to a 2014 IDGA report stating they haven't crunched in the past two years, compared to 24 per cent in 2004. But that means a whopping 80 per cent of devs have experienced crunch in the past two years.

Furthermore, some firms are becoming sneakier in how they encourage crunch, relying on peer pressure and the threat of layoffs rather than established overtime schedules. The problem isn't going away soon, and unless game industry culture is directly tackled, developers will be crunching for decades yet. **CPC**

> Some firms sneakily encourage crunch, relying on peer pressure and the threat of layoffs

Rocket League / £15 inc VAT

DEVELOPER Psyonix / **PUBLISHER** Psyonix / **WEBSITE** http://rocketleague.psyonix.com

OVERALL SCORE
85%

/ VERDICT
Accessible and thrilling, Rocket League is a summer game to savour.

Combining football with cars is such a brilliantly simple idea for a video game it's astounding nobody thought of it earlier. Well, someone did, but it doesn't really count if it's the same developer. Rocket League is a sequel to the 2008 game Supersonic Acrobatic Rocket-Powered Battle Cars, although with a name like that, Rocket League might as well be Psyonix's first stab at the concept. A good idea is worthless if you fumble the execution, as the absence of Battle Cars from the virtual history books demonstrates. Rocket League, on the other hand, takes this blend and hoofs it squarely into the top corner. It does vehicular soccer so well that it's enjoyable regardless of your viewpoint on either cars or football.

It's a multiplayer game in which two teams of up to four players take control of supercharged road hogs with pogo-stick suspension and an open relationship with gravity, then attempt to punt a ball the size of a building into their opponent's cave-like goalmouth. The team that scores the most goals within five minutes wins the match.

Fundamentally, it's football, albeit a simplified version. There are no throw-ins, no corners, no halves, no free kicks, no penalties and no offside rule. Playground tactics such as goal-hanging and shunting your opponent off the ball are entirely viable, as is slamming into them with such force that they explode. Rocket League doesn't encourage such pugilism explicitly. Rather, it cultivates an environment for

carefully contained chaos. The pitch is more of a bowl than a plane, with ramps at the edges that let both cars and balls roll up the walls. What's more, vehicles are able to jump, dive, flip and 'boost', all through simple button presses, enabling them to recreate some football-esque acrobatics, such as headers, sprints and bicycle kicks.

The result is an unpredictable, breathlessly paced sports game that's immediately accessible, and rewards skill and teamwork. The controls are straightforward and the cars highly responsive, meaning you can become acquainted with their handling within minutes. At the same time, the giant ball responds accurately to force. Ram it dead-centre and it rolls straight. Jump at it from underneath and it arcs through the air. Swipe it from the side and it chips off you at an angle. It's best not to think of your car as a football player, but as a rocket-propelled boot, striking the ball from different positions to angle it towards your opponent's goal.

> It cultivates an environment for carefully contained chaos

The complexity emerges from the game's systems, rather than any hard-coded rules or controls. Similarly, you rarely think about tactics. Most of the time, you react on instinct, as the ball bounces at an unexpected angle, or as another player strikes it just before you. The shape of the game is constantly shifting, and it's possible to pull off some impressive football feats, such as scoring a goal from your own half or bouncing it under the crossbar.

Initially, the temptation is to chase after the ball like an excited dog in a park. After a while, however, you learn to adopt some basic strategies, such as hanging back near the

centre of the pitch while other players jostle for possession, prepared to pounce on any loose balls for an easy shot at the target.

Nabbing that first goal feels fantastic, and the game knows how to make the moment special. As the ball passes over the line, it explodes in a cloud of blue smoke, the concussion sending cars flying across the pitch. Horns blare through the stadium, and the crowd thunders its applause. Rocket League captures that Saturday afternoon atmosphere superbly. It's also refreshing to experience it from the perspective of a lone player, rather than seeing the game through the faux-TV coverage that so many sports games weirdly emulate.

Given that you're only one player in a team of up to four, winning a match in Rocket League relies as much on the skill of your teammates as your own. This situation could easily be where Rocket League falls down, as venturing into online multiplayer is so often a roll of the dice when it comes to encouraging teamwork. Yet remarkably, Rocket League has one of the most pleasant online environments we've experienced. There's little in the way of anger and abuse, and the structure of the game seems to naturally funnel players into working together. Even players on the opposing team tend to be friendly, often complimenting a particularly clever shot or skilful save.

On those occasions where a player does drop out of the match in anger, Rocket League replaces them almost immediately. On the PC, the game's netcode is extremely robust. Finding new matches and transitioning from one round to the next usually takes less than a minute, and the game drops you into a freeform kick-about session if the process takes any longer. Such immediacy makes Rocket League ideal for quick sessions, nabbing a half hour of fun before work or during lunch.

If Rocket League has a problem, it's the fairly narrow optimal playing conditions. Although the game allows various player setups, only the 3-vs-3 one really offers the Premier League balance of skill and unpredictability. The 2-vs-2 setup is more Sunday League, while 4-vs-4 is like a comedy exhibition match – chaotic fun, but no form. There are levels and a series of unlocks to keep you engaged, but it's mostly cosmetic equipment, such as custom chassis, novelty aerials and so on. Again, these titbits are fun, but they won't be what keeps you playing.

Another, lesser issue is that aesthetically it's more functional than stunning. The orange and blue team colours certainly make it easy to distinguish between teammates and rivals, but they're also somewhat derivative – the colours of a thousand uninspired game boxes. Allowing custom team strips, or even procedurally generated colours in the vein of Nintendo's Splatoon, would lend Rocket League considerably greater visual variety. That said, the pitch grass looks lovely – if only the cars had fingers to run through it.

Ultimately, these quibbles are minor though. Like Counter-Strike and Team Fortress 2, Rocket League's replayability emerges from that captivating 3-vs-3 game mode. It's good, clean fun that will soak up a few minutes of spare time, or eat through an evening, and without any corruption or racist presenters in sight.

RICK LANE

The Swindle / £12 inc VAT

DEVELOPER Size Five Games / **PUBLISHER** Size Five Games / **WEBSITE** www.sizefivegames.com/games/theswindle

The Swindle's portrayal of criminal capers is refreshingly honest. In many crime games, being nabbed by the authorities only inconveniences you as far back as your last save. The Swindle offers no such artificial safety net. If your light-fingered larcenist gets caught by one of the game's many security measures, their career is put swiftly to an end.

This pilfering platformer sees you breaking into various buildings around a steampunk vision of Victorian London, stealing whatever you can find, and escaping before the police know you were there. Each heist is procedurally generated, so you never know what obstacles you'll face, and a single mistake can cost your thief their life, alongside all the loot you've accumulated on that level.

The game provides you with a new swindler each time one dies, but you only have 100 in-game days to practise your trade before the Met switches on a new security measure that effectively eliminates all crime in the city. Within that three-month window, you need to build up your funds and upgrade your gear enough so that you can steal Scotland Yard's latest toy. Every successful heist matters and each failed one is as painful as standing on an upturned plug.

The Swindle's theme might be thievery, but it's really about balancing risk and reward; analysing each room and figuring out the safest way to approach it. Can you break that window before the police robot (all in-game enemies are robots) turns and spots you? Can you make that jump without skewering yourself on that mobile spike-platform? Can you blow a hole through to the security terminal without setting off every alarm? Is it worth risking the £10,000 you've bagged for a potential extra £5,000?

As your funds increase, you can unlock new tech that allows you to be a more creative cutpurse. However, the

OVERALL SCORE
80%

/ VERDICT
It's well worth breaking into this charming, brutally honest burglary simulator to see what's inside.

Cradle / £10 inc VAT

DEVELOPER Flying Cafe for SemiAnimals / **PUBLISHER** Flying Cafe for SemiAnimals / **WEBSITE** http://flying-cafe.com

Cradle is a sci-fi adventure that places you in the body of convenient amnesiac Enebish, who wakes up in a yurt on the Mongolian steppe with no idea of his identity or why he's there. The only clue to the former is a series of instructions for making breakfast for someone named Ongots.

Through performing this everyday task, Cradle introduces you to its strange alternate future and what you'll be doing. The small space you inhabit is focused mainly on the yurt and its desolate surroundings. But what Cradle lacks in scope, it makes up for in detail.

Almost every object in the yurt can be picked up and examined, while posters, notes and newspaper clippings provide an insight into what's occurring in the wider world.

Initially, the action takes the form of searching through the yurt's clutter for specific objects and combining them with other objects, while gradually peeling back the layers of its fiction as you go about your daily routine. Cradle blends a gentle, homely atmosphere with an underlying sense that something is severely wrong with the game, which is reflected in the puzzles. For example, after cooking Ongots' breakfast, you move on to repairing an android in
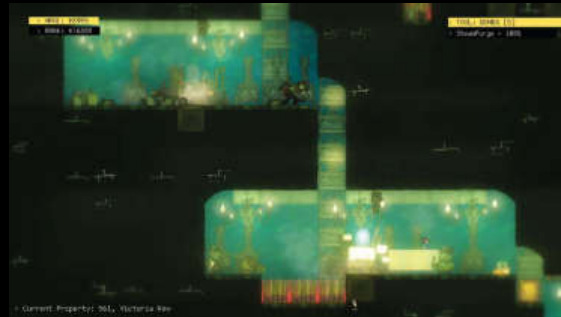
OVERALL SCORE
45%

/ VERDICT
Cradle's unique world and low-key, tactile puzzling is spoiled by a second half that's filled with tedious dialogue and irritating minigames.

progress path doesn't enable much variety – there's definitely a 'right' and 'wrong' way to go about building up to that all-important Swindle. Unlock an item at the wrong time, and you'll have to spend longer on the lower-level heists, which eat through those precious 100 days as if they were Maltesers.

There are a couple of other issues too. While the game's presentation is fantastic overall, with great art and an incredible soundtrack, the effect is slightly spoiled by a smoggy overlay that makes the screen look as if it's coated in Vaseline. Also, The Swindle isn't recommended for the easily frustrated. You'll make mistakes, and tantrums are par for the course in this game.

However, that frustration is also the natural product of a game about risk and thievery. There are severe consequences for getting caught stealing from someone, but that only adds to the thrill, and The Swindle's acknowledgement of that fact is ultimately what makes it so compelling.

RICK LANE

the hope of finding more answers about yourself, pulling off pieces of this humanoid and fiddling with her insides as if you're building a new PC.

Cradle's initial couple of hours are genuinely enjoyable – quietly mysterious and meticulously crafted. The only downside at this stage is that the controls are rather clumsy for a game that involves interacting with lots of small objects, which makes it easy to lose important items.

Unfortunately, though, when other characters appear on the scene, Cradle's quality nosedives. Its fascinating story, blending themes of transhumanism, the value of beauty and social exclusionism, is suffocated by tedious dialogue. The acting is flatter than the surrounding steppe and the writing possesses as much spark as a defunct robot.

Worse, the delightfully handcrafted puzzles are then eschewed in favour of repetitive minigames for which Cradle doesn't seem suited. They involve plucking Minecraft-esque blocks inside a virtual-reality simulation and throwing them into a gravity vortex to score points. These first-person platforming sections are totally vapid compared with the earlier puzzles, and combined with Cradle's controls, the end result is about as much fun as swimming through treacle.

With an ending that arrives unexpectedly to tie up all the loose ends, all signs point to Cradle enduring a difficult second half of development. It's a disappointment, especially given how the first half so carefully sets up a really interesting premise, and the idea of taking a small slice of a large sci-fi universe and exploring it in detail is wonderful. Sadly, it simply isn't worth persisting through the second half for the conclusion that Cradle finally reaches.

RICK LANE
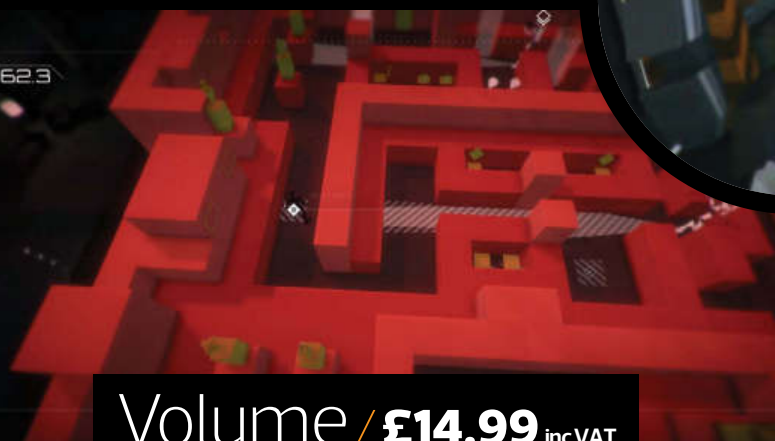
Volume / £14.99 inc VAT

DEVELOPER Bithell Games / **PUBLISHER** Bithell Games / **WEBSITE** www.volumegame.net

OVERALL SCORE

65%

/ VERDICT

A well-presented stealth game with some good ideas, but its rigid stealth systems make it less thrilling than the games that inspired it.

This vibrant sneak 'em up retells the legend of Robin Hood through the vocal talents of Andy Serkis and Danny Wallace. Combined with mechanics heavily inspired by Metal Gear Solid, on paper, Mike Bithell's Volume sounds fantastic. Yet in practice, although Volume clearly loves stealth, its own approach merely echoes better titles.

The game takes place in an alternate-future Britain ruled by a sinister arms manufacturer named Gisbourne. You play Robert Locksley, a rebellious hacker with a plan to take back the country's wealth hoarded by Gisbourne and his greedy cronies. With the aid of a reprogrammed military AI, Locksley runs simulated heists based on Britain's most lucrative targets, then broadcasts the simulations across the Internet as tutorials so that viewers can attempt the robberies for real.

It's an interesting premise that tackles culturally significant themes, such as the unifying power of the Web and the divide between rich and poor. Unfortunately, though, most of the story is told rather than shown, and the fact you're playing simulations makes you feel oddly disconnected from the threat of your enemies and the impact of your actions. The story does address this problem at one point, but never resolves it.

Nevertheless, the script is written with flair and fun, while Serkis as Gisbourne and Wallace as your chirpy AI companion both deliver strong performances. Locksley himself isn't as compelling, though, as YouTuber Charlie McDonnell's performance isn't up to the same standard as that of the other actors. Throughout his upsetting of the country's entire infrastructure, the main emotion Locksley conveys is boredom.

During play, Volume involves sneaking through brightly coloured levels, collecting all the diamonds dotted about the map and then finding your way to the exit. You must evade the watchful patrols of guards, using noises and gadgets to distract and confuse them. The top-down perspective and colour-coded visuals make figuring out your next task simple and straightforward, and the brief yet numerous levels (100 in the main game alone) lend Volume a compulsive rhythm.

However, the stealth aspect is much more puzzle-based than its systems initially imply. Aside from a few edge-cases, there's nearly always a right and wrong way to approach a situation, and if you choose the wrong option, the guards will usually kill you before you can react. The 'evasion' stage that's so crucial to exciting stealth gaming is almost entirely absent, as is the opportunity to approach problems from different angles.

Where the best stealth games are fluid and analogue, Volume is prescribed and binary. The speed with which it throws problems at you keeps it engaging, but even with its sharp script and heavyweight acting talent, Volume never elevates itself beyond a moderately pleasing brain tickler.

RICK LANE

How 3D-printed rats could offer schools a vegetarian dissection

RICK LANE / THE ENGINE ROOM

Adventure Game Studio

Rick Lane speaks with Wadjet Eye Games about the most prolific game engine you've never heard of

While the majority of engines are designed to cater for a broad range of game types, Adventure Game Studio is entirely focused on a single genre – 2D adventures in the vein of those developed by LucasArts in its heyday. Yet unlike SCUMM, which was evolved to be used by a very specific set of people, AGS is a one-stop design shop intended for everyone regardless of skill level.

'There's something very powerful about working with the tool that knows exactly what you're trying to do,' says Dave Gilbert, CEO of Wadjet Eye Games, a New York studio that's created 15 titles using AGS over the past decade. 'You want to create a character; it knows what a character is. It knows that a character walks and interacts with things; that it has an inventory, a walk cycle and a talking animation ... the engine just knows all that.'

Adventure Game Studio was created back in the mid-1990s by an enthusiastic teenage programmer named Chris Jones. A lover of classic adventure games, Jones fancied trying his hand at making one of his own. Without any game creation software easily accessible at that point, Jones decided to build some himself.

Jones' first prototype, Adventure Creator, was completed in 1995, but by that point, he'd decided he lacked the design skills necessary to build an adventure game, so he abandoned the project entirely. A couple of years

Dan Marshall, creator of The Swindle, used AGS for his adventure game Time Gentleman, Please!

later, he returned to Adventure Creator, and decided to make it freely available online as an updated program called Adventure Game Studio. The response he received, along with the resulting games that were built with it, motivated him to support AGS, for free, for the next ten years.

In terms of features, AGS bears a certain amount in common with GameMaker, using a combination of comprehensive drop-down menus and simplified scripting commands that enable developers to take an adventure game project from start to finish, only leaving the program to import files such as sprites and sounds. Its functions include the ability to edit rooms, write dialogue directly into the game, design

customised inventories and interfaces, and so on.

Unlike GameMaker, however, AGS can assume knowledge of the game you're trying to make, and cater its tools towards specific purposes. It can provide hard-coded commands, including mouse-cursor functions such as 'Walk To' or 'Look At' right off the bat, while also offering template commands you can adapt to your particular design.

This doesn't mean you can start designing a game immediately – it needs to be learned like any other tool, but doing so is a lot easier than, for example, learning how to program in C, or deciphering a more complex engine such as Unity.

It was the simple and specific nature of AGS that attracted Gilbert
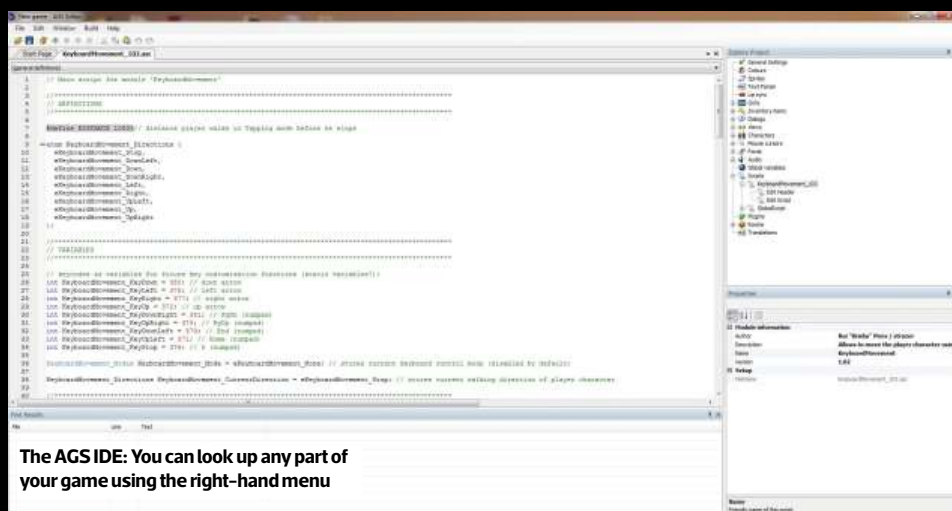
The AGS IDE: You can look up any part of your game using the right–hand menu

in the early 2000s. 'There was this weird period of my life where the World Trade Center had just gone down, I lived in New York and I was looking for something to keep my mind off stuff,' Gilbert says. 'So I downloaded the engine, played around with the tutorials and made a little game. What appealed to me at the time was that I was able to just do it. There wasn't really anything else like that available.'

Fourteen years and fifteen games later, Gilbert and his team at Wadjet Eye know the engine inside out.

The team's games include the critically acclaimed Blackwell series, a single adventure that ran over the course of five games, and Resonance, co-programmed by developer Vince Twelve and Wadjet Eye's CTO Janet Gilbert.

'I'd say Resonance was our most ambitious game on a technical level. We had a lot of really slick interfaces and graphical effects, and all sorts of neat little tricks and fun little things to do that had never really been done in an AGS game before.' The features include an innovative memory system that runs alongside the

traditional inventory, which enables you to store 'memories' taken from the environment and use them later in conversation.

During its lifetime, AGS has formed the basis of thousands of adventure games, but the past few years have proved difficult for the software. Between 1999 and 2006, Chris Jones constantly supported AGS, releasing an updated version of the engine approximately once a month, free for anyone to use. Then in 2007, Jones decided to step back from the engine, releasing the source code to the community and moving on to other projects unrelated to AGS.

Since then, the process of updating AGS has been complicated. With no

The Black Well Legacy was one of Wadjet Eye's earliest games, released in 2006

single individual in charge of the updates, it has been up to the community to pool together and attempt to update AGS when necessary. Updates have been released since then, which is an achievement in itself, but the process is much slower, with multiple differing version of the program available.

'It was very nice having a singular vision,' says Gilbert. '[Jones] made a new version of AGS, and that was officially the new version – all new features went through him; it was this nice way of updating the engine; and sadly now no one has really officially stepped up to the plate.'

Many of the problems lie with compatibility. Gilbert notes myriad issues with dual-monitor setups, mouse acceleration and interfacing with other programs such as Steam. 'My wife is the real programmer type and, from what she tells me, AGS uses a lot of really old, outdated libraries, and things get a little weird as more modern systems stop using and supporting those libraries.'

The most prominent flaws with AGS all relate to resolution. You can't adjust from full-screen to windowed mode, for example, and if you change your resolution setting, AGS alters your monitor settings to fit the game, rather than altering the game to fit your monitor settings. 'Ironically, the more souped-up, and fancy and powerful your gaming rig, the less likely it is that an AGS game will work on your computer,' Gilbert says.

Moreover, as technology accelerates, AGS falls further behind. Wadjet Eye has even offered to pay someone to grab AGS by the horns and update the engine to suit its needs, but so far nobody has stepped up. Now Gilbert is pondering whether to continue using AGS for Wadjet Eye's next game, or learning an alternative engine, which in itself could take the same time as making a game.

'For the majority of players, it works fine. My only worry is that it won't be fine in another decade. It won't get updated very fast, so that's my concern. However, it's pretty damn amazing for an engine that was built in 1999 to still have relevance today,' Gilbert says. **CPC**

Resonance has a unique memory system that lets you discuss any object with any character in the game

One of the most recent major AGS games was Owl Cave's Charnel House Trilogy

CUSTOM PC
MAKES A VIDEO GAME
PART FOUR

Rick Lane introduces a complicated third weapon to our spider game, as well as a weapon with ammo, while inadvertently creating a level system

In part three, we created a shotgun that fires wasp-stings, but failed to create a grenade-type weapon, so this was the first priority upon return. The idea was to create a ball of sticky web that would inflate like a balloon when triggered (to simulate the spider 'spinning' the web-ball) before being fired a certain distance and exploding. Unfortunately, getting the code right for inflating the web-grenade proved tricky, resulting in horrible deformations of the grenade-sprite.

In the end, we ditched the inflation idea, and focused on getting the weapon working as a grenade. We wanted an object that fired away from the player, had a timed delay and then exploded into several fragments that affected the enemies. We needed to create three individual objects – each with its own code, plus adding extra code into two further objects to make them respond to the grenade appropriately.

Firstly, there was the grenade weapon itself, which needed to be picked up by the player at the start of the game, then coded to fire when the mouse button was pressed. This technique was familiar to us by now, so it didn't take long to implement. Up next was the projectile element, which is a separate object from the weapon element. So, in literal terms, we created a grenade that fires grenades. Game design is weird.

Again, this job involved familiar commands. In fact, the weapon element does most of the work in terms of establishing the speed and direction at which the explosive is fired. But there was one additional component – the detonation timer, which the explosive conducts on its own. GameMaker counts time in frames rather than seconds, and as standard, runs at 30fps. So we created a variable named 'counter' in the explosive's creation script, and set it to 90fps (three seconds). Then, in a separate 'Step' script (which the game checks at every frame) we told the game through code that 'if the counter is greater than zero, count down by one number, otherwise explode the grenade'.

That way, when the counter hit zero, the grenade would explode and, because GameMaker checks the script 30 times a second, the grenade would explode after three seconds.

The final element the grenade required was fragments to emit post-explosion. Our spider theme dictated that, like the grenade, the fragments should be webby. However, we had already created a weapon that traps enemies in a web, so ideally we wanted a different function. Eventually, we decided that the grenade should explode into a sticky goo that slows down enemies.
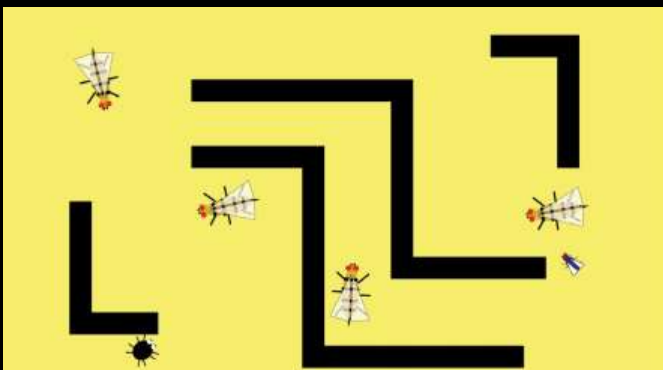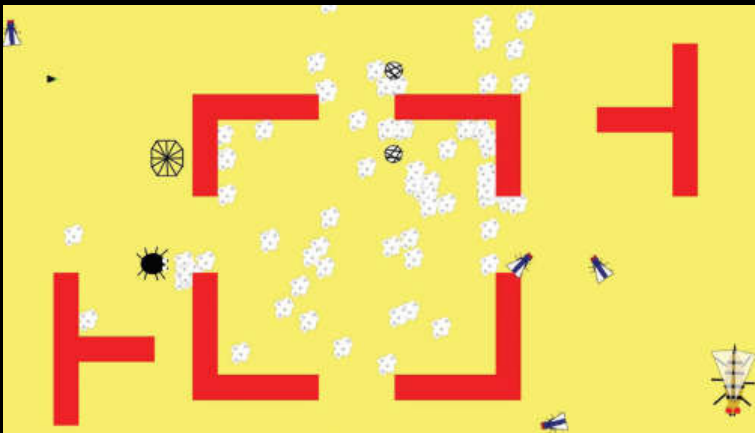

It's now possible to prototype level layouts within minutes
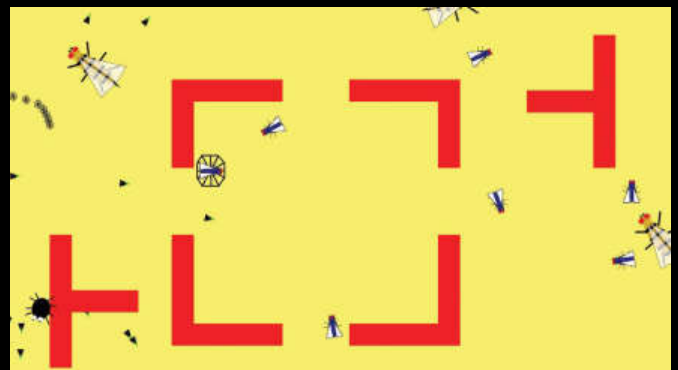
Change the block sprite's colour and you change the colour of the entire level
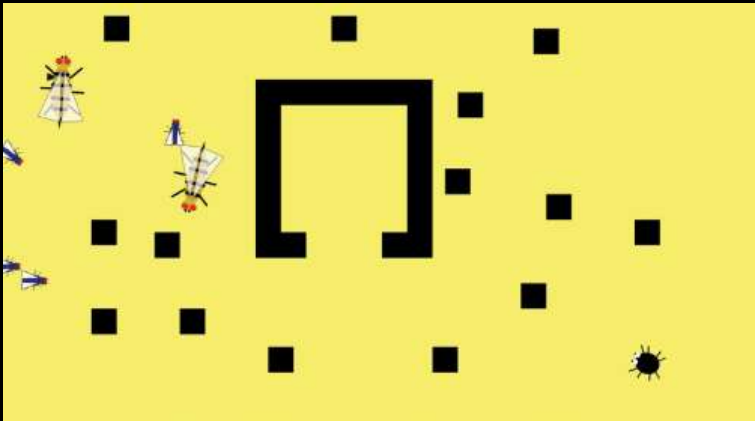
Achieving this goal involved using a combination of old and new techniques, including creating a third object and accompanying sprite to represent the bits of goo. The simplest part of the code involved creating the end effect of slowing down enemies when they stepped on the goo, as we knew how to set the speed of an enemy and tell it what to do when it occupies the same space as another object.

There were two trickier tasks, however. The explosion script we created for the wasp had fragments that move forever, but we needed our goo to slow down and stop so that it could act as a trap. We need to create a 'deceleration' code that works in a similar way to the detonation timer for the explosive. It tells the game that 'if the fragment speed is greater than x, reduce it by y per-frame, otherwise speed equals zero'.

Finally, we didn't want the goo lingering forever, but we also didn't want it to simply disappear. Cue Tom Francis swooping to the rescue, introducing us to the statement 'image_alpha' in his very next YouTube tutorial. This statement

defines an object's opacity, and if you reduce the value of an object's image_alpha over time, you get a fading effect, which is much more visually appealing than objects abruptly vanishing from the screen.

Phew, all that work just to make a grenade, and it still doesn't do everything we want! That said, at least it's functional, and that's enough for the moment. We just needed to do one last job with the weapons. Compared to the grenade and the web-shot, the sting-shotgun was massively overpowered. We wanted to reel it in a little, so we added a rudimentary ammo system.

Again, this job involved a similar process to the grenade's detonation

timer. First we created the variable, 'ammo = 5'. Then we told the game to only register the player's mouse click if 'ammo' is greater than zero, while at the same time instructing it to reduce 'ammo' by one number with every mouse click. That way, after five clicks, ammo hits zero and the Sting-Shotgun stops working. To refill the ammo, we created a new object using the same sprite as the wasp sting and instructed the wasp enemy to 'create' that particular sting underneath it when it dies. When the player picks it up, it adds +5 to the ammo count and the shotgun works for another five clicks. Eventually, we'll need to display that ammo count on-screen, but the system now basically works.

With all our weapons functional and relatively balanced, we moved to implementing collision. It's one of the nastiest tasks in game development, and one through which Francis' tutorials guide you as painlessly as possible. At the simplest level, collision functions by telling one object to stop moving when it hits another object. However, because collision can occur at different angles, and because games move in individual frames, it can be hard to ensure collision works constantly and consistently.

We won't bore you with the more tedious aspects of collision, but there was an excellent side effect of implementing this system. To test collision, you need a static object with which to collide, which in our case was a simple black square. Put a few squares together and you get a wall, put a few walls together and you get a room, put enough rooms together and you get the layout of a level. In short, we can now quickly prototype maze-like level layouts by placing blocks. Hurrah!

Determining how an object collides also allows for interesting ideas. For example, we programmed enemies to bounce off walls at a random angle between 45 and 180 degrees. We also coded our grenade to bounce off walls at 45-degree angles, enabling the player to rebound grenades around corners. In the next part, we'll explore collision further, and hopefully see more structure emerge. **CPC**

Hobby tech

The latest tips, tricks and news in the world of computer hobbyism, from Raspberry Pi, Arduino and Android to retro computing

ANALYSIS
Thermal vision for the hobbyist

I've always wanted a thermal vision camera, even if I've never really been able to articulate exactly why I want one. Frankly, I blame seeing the classic Arnie flick Predator at an impressionable age. Sadly, while thermal vision may well be real, until recently it was also really, *really* expensive. A low-resolution thermal camera would have cost tens of thousands of pounds at the time of Predator, and even a few years ago, the cost would still have been in the low thousands.

Now, though, the market has shifted. The launch of low-cost thermal imaging sensors has flooded the market with sub-£1,000 thermal camera systems, bringing the technology into the reach of the hobbyist for the first time. From the Seek Thermal, a crowd-funded device that connects to your smartphone, to Flir's hand-held C2, it's now possible to get your hands on a thermal imaging system without breaking the bank, which only leaves you looking for an excuse to own one.

As I prepare for the arrival of my second child – yes, yes, congratulations and commiserations to me – I've been getting rid of the bulk of my vintage computing collection, in order to turn the home office into


The Flir C2 isn't cheap, but it's a bargain compared with traditional thermal cameras

a bedroom. This situation has, in turn, led to a sudden influx of cash for spending on shiny new kit – and with the cost issue sorted, how could I resist purchasing a thermal camera of my own?

Just over £600 inc VAT later, I was the proud owner of the Flir C2. While Flir makes a lower-end model, the Flir One, which connects to an iPhone much like the Seek Thermal, I specifically wanted a dedicated device – even if it meant doubling my budget. The C2 ditches the gun-like shape of most thermal cameras and visual thermometers in favour of a design that looks much like how 1990s Hollywood might have imagined a ruggedised, touch-screen smartphone.

At the hobbyist end, it's important to manage your expectations. With even entry-level smartphones now boasting Full HD video recording and eight-megapixel photo
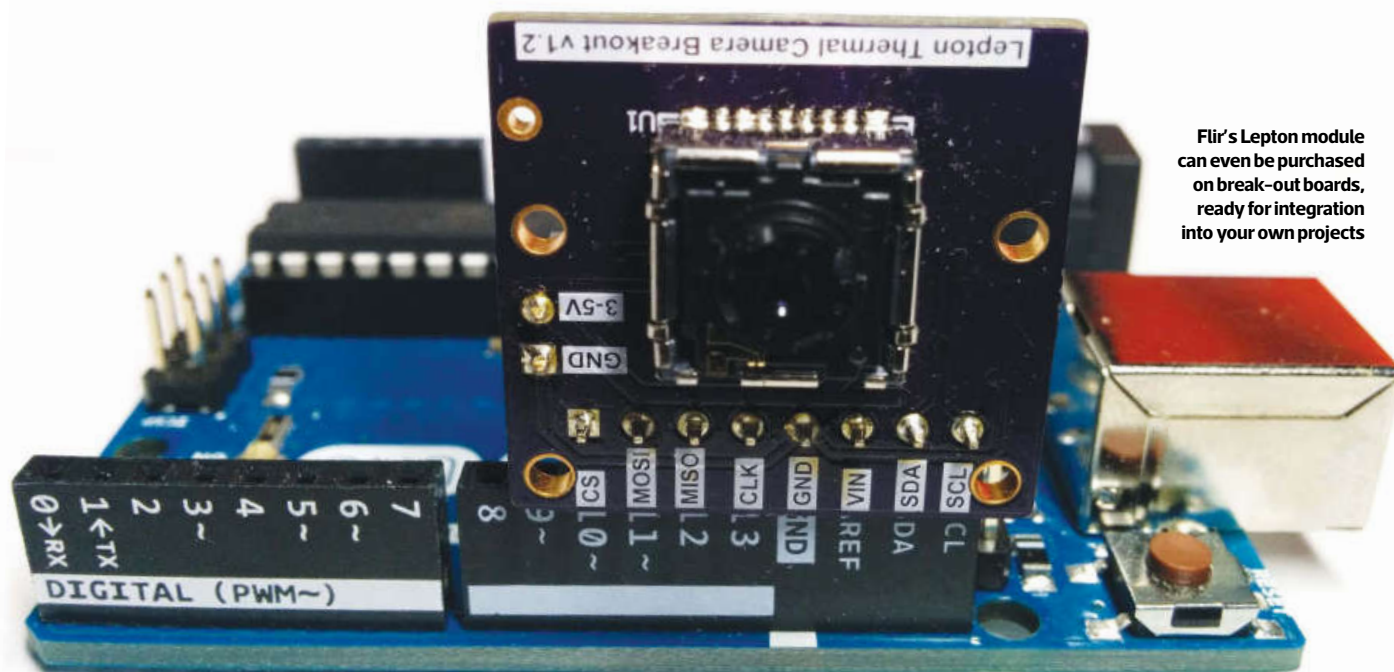
Flir's Lepton module can even be purchased on break-out boards, ready for integration into your own projects

shooting, the numbers on offer from the Flir C2 seem laughable; its 0.3-megapixel fixed-focus visible-light camera captures a 640 x 480 image, which can be blended with the 80 x 60-pixel (not a typo, that's the actual resolution) thermal camera's readings to produce a 320 x 240 finished picture.

This blending uses what Flir calls MSX: Multi Spectral Dynamic Imaging. With an 80 x 60 image lacking detail, MSX overlays the thermal shot onto the higher-resolution visual shot to bring out details that would otherwise be hidden. For its intended purpose – building surveys, electrical work and so on – it works perfectly, and is a major feather in Flir's cap.

Unfortunately, now I'd spent £600 on the C2, I needed to justify the purchase – and I don't conduct very many building surveys. I'd previously decided that a thermal camera would provide a fun way to add more depth to hardware reviews, but ran into a glitch: at a distance of less than 1m, the MSX image fails to align the thermal and visual images, as you can see in the shot of a Raspberry Pi included in these pages.

Thankfully, there's a healthy community of hackers who have reverse-engineered Flir's

image formats. The file that appears at first glance to be a simple JPEG featuring either thermal or blended images, depending on the C2's mode when the shutter release was pressed, actually contains raw thermal data, a full-sized visual camera shot and other

A new generation of smartphone-driven thermal cameras, such as the crowd-funded Sleek Thermal, is driving down costs

goodies that can be extracted. Once extracted, it just takes a few moments to overlay the thermal image with the visual image in GIMP, my image editor of choice, and my plan is back on track.
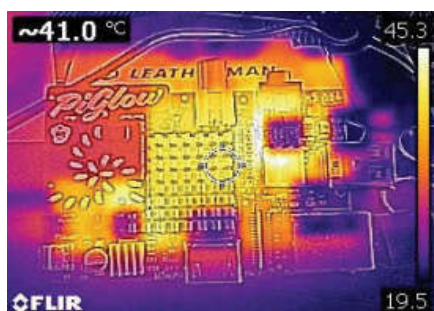
But what about other hobby uses? I found the camera was invaluable in quickly checking for overheating components that could benefit from heatsinks, and also for checking the performance of the heatsinks themselves: the smaller heatsinks visible in the Pi shot can be clearly seen to be cooler than the chips they're supposedly cooling, suggesting that my cheap thermal tape isn't doing its job properly. It can also be used to see which parts of a circuit are live at a given time – it's sensitive enough, I found, that it would show which of the USB power cables on my desk was currently charging my tablet, for example.

Of course, £600 is a lot to spend for these uses, admittedly – but the cheaper options, such as the Flir One and the Seek Thermal, could prove useful additions to the hobbyists' toolkit – and the future's even cheaper models are likely to really add some heat to the market. Flir's Lepton sensor, found in the One and C2, is already available in a format suitable for connecting to microcontrollers and microcomputers directly, dropping the entry price to around £160 for anyone with a thermal imaging project in mind.
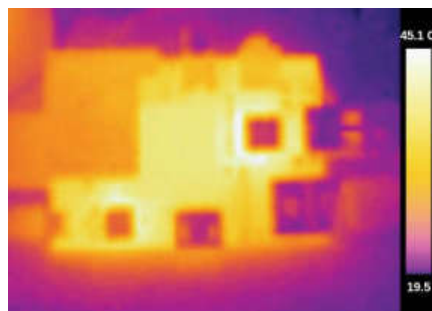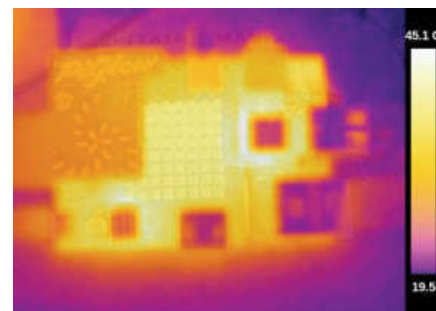

The Flir C2's MSX blending feature struggles at distances of less than 1m

The original thermal image can be quickly extracted from Flir's odd feature-packed JPEG-variant image

A few minutes in GIMP provides an MSX-style image with far more accurate alignment

REVIEW
Novena Desktop

Fans of open hardware are spoilt for choice when it comes to single-board computers: from the creations of major corporations such as Imagine's Creator CI20 to the wonderful kit from Bulgaria-based Olimex's labs. Open hardware laptops are trickier though. Traditionally, hardware hackers pick up a junky old Lenovo ThinkPad, but these laptops are far from being open: as well as the usual proprietary bits, Lenovo also creates a hardware white list in the BIOS that blocks unauthorised devices – at least, until you install a hacked BIOS. Accordingly, Hacker Andrew 'Bunnie' Huang decided to design a truly open hardware laptop, the Novena.

Based on a single-board computer of his own design, the Novena took crowd-funding site Crowd Supply by storm, generating a total fund of more than $780,000. The basic single-board computer design was available to buyers in three variants: the bare board, a desktop variant and a laptop variant with a built-in battery charging circuit that, amazingly, is also fully open and hackable.

It's only recently that I've had a chance to play with a Novena, in its desktop guise, and it's fair to say the machine is everything I had hoped. Based around a powerful Freescale i.MX6 quad-core system-on-chip processor running at 1.2GHz and featuring embedded Vivante GC2000 graphics sharing 4GB of RAM – for which fully-open drivers have been written, thanks to a crowd-funding stretch goal – plus a Xilinx Spartan-6 FPGA co-processor, the Novena is pretty flexible. In use, the machine is fluid and responsive, and while you wouldn't want to try to do heavy image editing, video work or code

It's not for everyone, but the Novena ticks a lot of boxes for hackers and tinkerers

compilation on the Novena, it's unlikely it would be your only system anyway.

Where the Novena excels is in being hackable. Every aspect that can be open is open, from the design of the single-board computer itself to the software it runs, the aforementioned battery charging circuit and even the case itself. Here, too, the Novena bucks tradition; the desktop Novena looks like a laptop that's been assembled incorrectly. A 1080p display panel faces outwards and springs upwards on a gas strut at the push of

a button, ending at a comfortable angle for desk use. With the display pushed back flat against the rest of the chassis, the Novena can also be wall-mounted.

The pneumatic action of the display uncovers a further feature of the Novena too: it's all exposed internally. It's the only PC I've ever used which comes not only with a set of screwdrivers for assembly but also a bottle of thread-locking solution, and you're expected to fit the display panel yourself – a fiddly but far from difficult task.

**Screwdrivers are provided, but the use of standard parts means you can use your own tools**
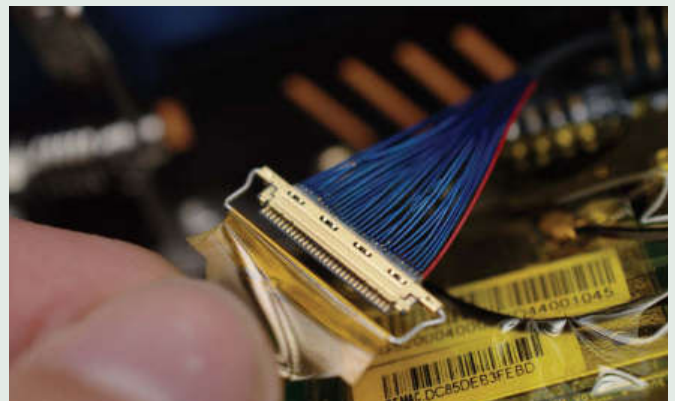
Installing the Novena's display panel is a fiddly job, but thankfully, it doesn't take too long
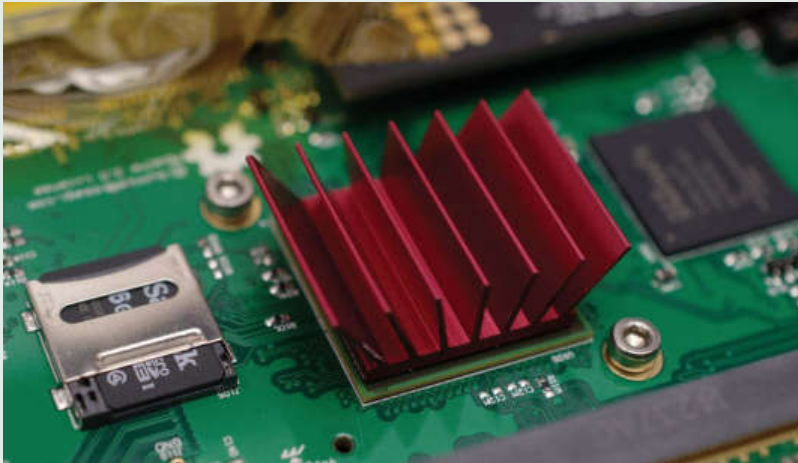
Passively cooled, the Novena runs silently, although the FPGA may need additional cooling

Add-on modules can provide Raspberry Pi compatible GPIO, microcontrollers or even software-defined radio capabilities
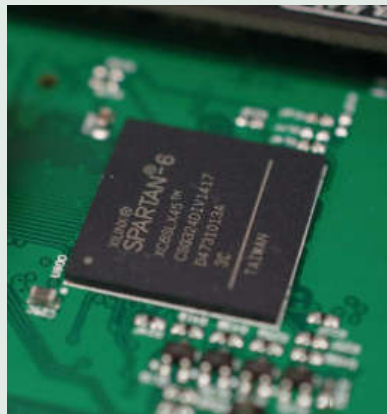
An on-board FPGA provides plenty of power for those who like to synthesise their own chips

Folded up, the Novena can be wall-mounted to provide a unique all-in-one device

The Novena single-board computer takes up a tiny portion of the case's interior, with the rest housing what the project's team calls the Peek Array, a series of embedded screw points, arrayed in a grid, which allows the mounting of any additional hardware you care to name. For example, you can use it to house the bundled stereo speakers, or leave the system mute in order to have maximum space for prototyping your own devices.

Bunnie is a hacker, and it shows in the design of the Novena. It's as far from a mainstream system as you can get, but even its negative aspects – the bulky case, with its exposed screw heads, for example – are positives when viewed from a tinkerer's perspective. It will be interesting, too, to see where the community takes the design, with boards already available, which add features that range from a Raspberry Pi compatible GPIO header to a Myriad-RF software-defined radio module. The latter is powerful and flexible enough that it's possible to run your own mobile base station from the device, should you wish.

At the same time, it's these features that make the Novena impossible to recommend to anyone who doesn't like fooling around with their systems. Many of its features, such as the ability to pretend to be a USB device, will be of no interest to anyone except hackers, and its high price means you're paying for the privilege of having an unusual device without gaining any of the benefits beyond poseur value.

If you're one of the blessed few people clever enough to make full use of the Novena's features though – and I'm excluding myself from that select group, although I'm lucky enough to hang around with some very clever people indeed who think the Novena is just wonderful – then the $1,650 (around £1,057 ex VAT) asking price is more than justifiable.

For everyone else, though, just think how many ThinkPads you could have lying around the house for the same amount of cash. You can find more information about the Novena at **www.kosagi.com**

NEWS IN BRIEF

Windows becomes Arduino-compatible

As announced earlier this year, Microsoft's Windows 10 is Arduino Certified, and now Microsoft has put its money where its mouth is with a guide on using the Windows Remote Arduino (WRA) system to connect a Windows 10 device to an Arduino microcontroller via Bluetooth or USB. While basic, the instructions provide a glimpse of how Microsoft expects Windows developers to use the existing API formats to address what for many will be an entirely new class of device. The instructions are live now on **https://dev.windows.com/en-us/iot**
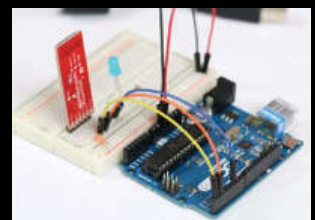
ANALYSIS
The Sinclair ZX81 'cockroach' fix

Long-term, regular readers may remember when I built a Sinclair ZX81 microcomputer from scratch in Issue 109, from an original and unused kit, for reasons that I'm sure made sense to me at the time. What you may not know is that this kit wasn't the only ZX81 I owned: as well as an unboxed unit, I had a boxed unit I bought out of curiosity, after seeing that the box differed to my kit version in having only a slip cover on the outside of the polystyrene. Taking the ZX81 inside the box apart, I discovered that it was a rare beast indeed – a 'cockroach' first-production-run model.

Sinclair was a company with a fast-and-loose approach to product launches. Typically, it would begin advertising a product for mail-order purchase before it had quite entered production – and occasionally before it had even left the drawing board. The promised 28-day delivery schedule – which seems archaic in today's world of instant gratification and next-day delivery – gave the company wiggle room, allowing it to partially fund production using cash from what it had failed to tell its customers were basically pre-orders – it was like a murky, not-terribly-honest precursor to today's crowd-funding campaigns.

This situation, naturally, could lead to problems when issues pushed back production dates. The ZX81, designed to replace the ZX80 and offer a greatly reduced
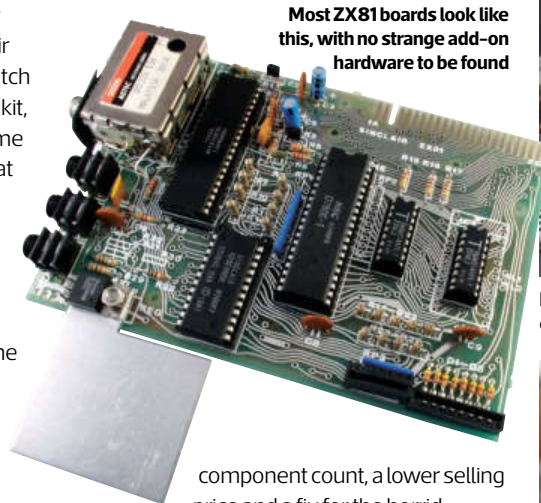

Most ZX81 boards look like this, with no strange add-on hardware to be found

component count, a lower selling price and a fix for the horrid screen flicker every time you pressed a key, had just such one problem: when the first units were assembled, a bug in the read-only memory (ROM) was uncovered that rendered them unusable.

Back then, that bug was a serious problem: while the programmers could fix the ROM firmware quickly enough, it would take time to have new ROM chips built - and, worse, leave Sinclair with a number of scrap ROM chips eating away at its bottom line. With customers already wondering why they hadn't received their ZX81s, Sinclair was left with three options: ditch the chips and tell customers they could be waiting several more weeks for their machines; ditch the chips and build the first few units with expensive EPROM chips
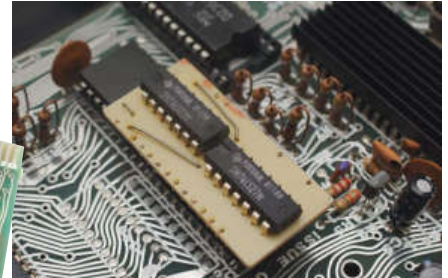
Built to work around a ROM bug, the cockroach is an extremely rare sight
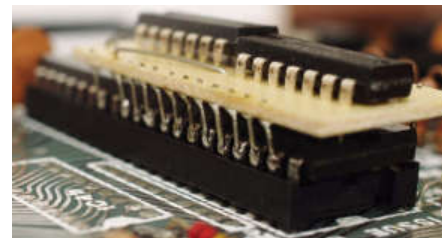
Every cockroach was hand-assembled and hand-soldered to the ZX81's CPU

that could be burned in-house; or keep the chips and find a workaround.

Naturally, the thrifty Sinclair chose the third option, instructing its engineers to find a way to make the faulty chips work at any cost – likely with a few expletives from Clive thrown in for good measure. The solution was a daughterboard soldered directly to the Z80 CPU, which contained two logic gate modules. When the ROM fault was encountered by the system, the logic gates cleverly worked to correct the issue, so the faulty ROMs could be used after all.

In terms of manpower, the fix was a joke: dubbed the 'cockroach', the module had to be assembled from a piece of Veroboard by hand, then carefully soldered directly to the CPU legs – again, by hand. For Sinclair, though, the fix made perfect sense: there was no stock wastage and the cost of the hardware was a fraction of the cost of an EPROM. Best of all, it could be turned around relatively quickly compared with waiting for new ROMs.

I'd like to say Sinclair learned from this mistake, but I'd be lying: the ZX Spectrum had a similar cockroach applied to the ULA, and the ill-fated QL shipped with half its memory literally hanging out the back of the machine, but those are tales for another day. **CPC**

Gareth Halfacree is the news reporter at www.bit-tech.net, and a keen computer hobbyist who likes to tinker with technology. @ghalfacree

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Water-cooling Skylake

The Skylake CPU samples we've tested appear to have just as much overclocking potential as their Haswell counterparts. In fact, they're able to handle higher voltages and, although it's early days, I've seen encouraging signs that 5GHz will be an easier target for Skylake than Haswell too.

As usual, though, heat was the limiting factor in my test rig, so I set up a water-cooling system with a Core i7-6700K, Laing D5 pump, Phobya UC1-LT waterblock and full-height triple 120mm-fan radiator to assess the impact of water-cooling Skylake. At 4.8GHz using 1.35V, the water-cooled CPU was 10°C cooler than with a Corsair H80i GT on its maximum setting, reaching a delta T of 57°C.

Pushing the clock speed above 4.8GHz was the point where the required voltage rose exponentially. We needed 1.38V to get to 4.9GHz and 1.42V to reach 5GHz. The latter frequency pushed our cooling setup to the limit, though, with the temperature approaching 100°C in Prime95. Needless to say, this clock speed was beyond the reach of any all-in-one liquid cooler, and our system wasn't 100 per cent stable at either, though I suspect a little more fine tuning could make it solid enough.

As usual, though, the water-cooling setup was much quieter than any all-
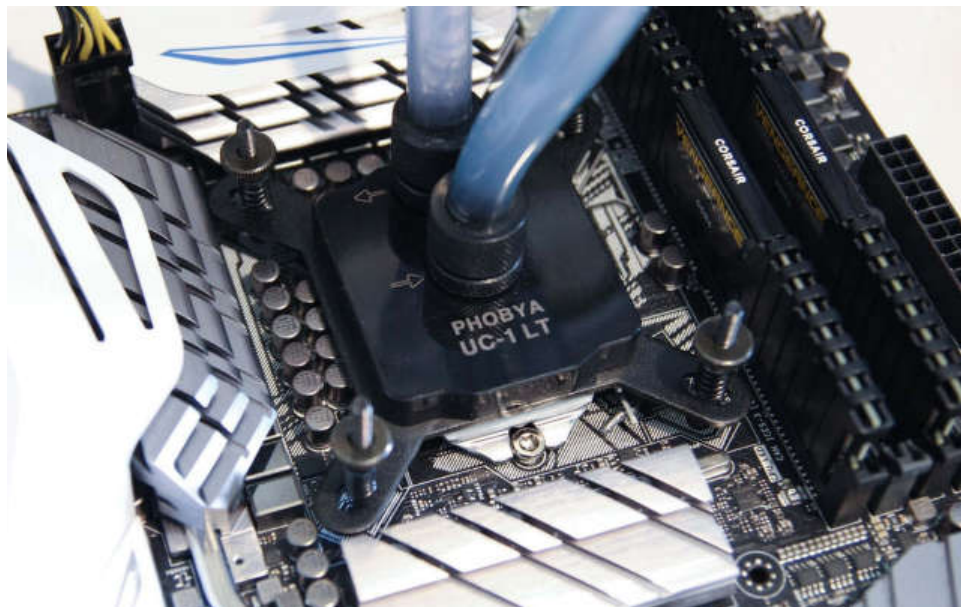
Our water-cooling system enabled us to push our Skylake test rig to 4.9GHz, but it needed a 1.38V vcore

in-one liquid cooler I've used, and it allowed for a slightly higher overclock too, so it's still definitely worth water-cooling a Skylake system.

Hands on with Mayhems Glass tubing

Copper tubing was the first rigid tubing we saw in water-cooling systems, then came acrylic and then a different form of acrylic – PETG, which is far stronger and less brittle than standard acrylic tubing. You can also buy pre-bent metal tubing from Aquatuning, but there's now another kid on the

block – glass tubing. Mayhems recently announced on Facebook that it was working on offering glass tubing and sent a few modders (including me) a selection of samples – it's now available on Mayhems' website at http://mayhems.co.uk in 12 and 16mm sizes.

You can instantly tell that you're dealing with glass, as it's heavy and makes a distinctive clink as the tubes knock together. It also offers a luscious, clean view of the internal coolant that's missing from acrylic. There are a couple of downsides
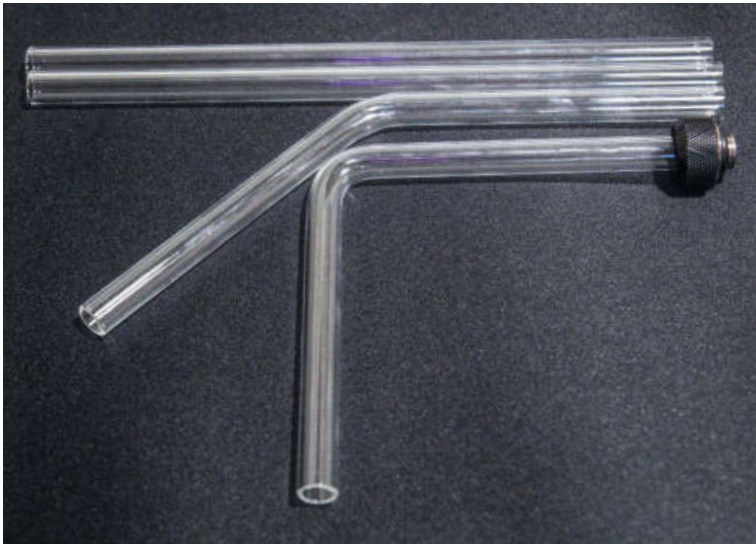
though. It's pretty much impossible to bend – Mayhems initially offered pre-bent sections, but they're unlikely to be made available for retail due to manufacturing issues.

As such, only straight lengths are available for now. Being glass, there's also the worry of it shattering too, although I took a hammer to mine and, with medium force, it stood firm where normal acrylic shattered – it's much stronger than standard acrylic tubing.

I talked to Michael Wood from Mayhems about its new tubing, to get an insight into its benefits. 'I was basically sick and tired of people asking Mayhems for glass-like tubing,' says Wood. 'They were referring to the quality of the acrylic, but I just thought ''why not offer the real thing – glass?'' It's non-staining and will essentially last a lifetime. It's also stronger than normal acrylic, it can aid heat dissipation, and it doesn't expand and contract as much as plastic. It also looks a lot better too. It's not as strong or flexible as PETG tubing, but we find the latter always has imperfections, which look poor when you fill your system with coolant. We're actually working on our own PETG tubing as we speak.'

Wood also clarified that more sizes of tubing will be available. 'We currently offer 12 and 16mm outside diameter (OD) sizes, but we'll be introducing new sizes to cater for popular fittings such as 13mm OD too,' says Wood. 'We're also in the process of increasing the wall size. It's much easier to work with the new size of 12mm, and it's stronger. For anyone who is interested, we've found the best fittings are the ones with two O-rings that don't put pressure on the sides of the glass.'

I also spoke to Daniel Harper, a former Readers' Drives modder who has used glass tubing before, about how you work with it. 'I've found the best way is not to cut it all, but to use hot and cold water,' says Harper. 'I score around the section to be cut – you can use a diamond stylus, tile cutter or glass cutter. I found that using an appropriately-sized rubber grommet helps as a template here. I heat the tubing in hot water and then plunge it into cold water; thermal stress does the rest. The result is amazing and you don't have to deal with any nasty glass dust. Afterwards, I use a small blow torch to smooth off the ends.'

Hands on with BitFenix magnetic LED strips

There are many ways to light up your PC's interior. You can use string lights, individual LEDs and plenty of water-cooling accessories can be illuminated thanks to LED inserts. However, the most popular way and effective way is to use LED strips – long interconnected strands of LEDs that light up in a continuous line. They're very bright, so even a small strip will deal with most small to medium-sized cases. The only aspect of LED strips I don't like is that they use adhesive strips to stick them to your case. As such, you need to be careful when applying them, but even then they can often peel off after a few months, or come away if your PC gets hot in the summer.

Thankfully, BitFenix has a brilliant answer to this problem – magnetic LED strips. They're Molex-powered and, like the self-adhesive strips, come in a range of lengths and colours. I was a bit sceptical at first, as some magnetically attaching parts I've tried haven't worked too well, but the magnets used in BitFenix's LED strips are very strong – certainly enough to hold onto a steel case with the Molex cable dangling from it.

The downside to magnetic strips is that they won't obviously work with aluminium, but for cases made from magnetic material, they're much less fiddly and more likely to stay put than their sticky equivalents. **CPC**

You can instantly tell that you're dealing with glass, as it's heavy and makes a distinctive clink as the tubes knock together

BitFenix's magnetic LED strips offer the brightness of standard strips, but they're more likely to stay put than their sticky equivalents

···························· **Antony Leather is Custom PC's modding editor** 🐦 @antonyleather ····························
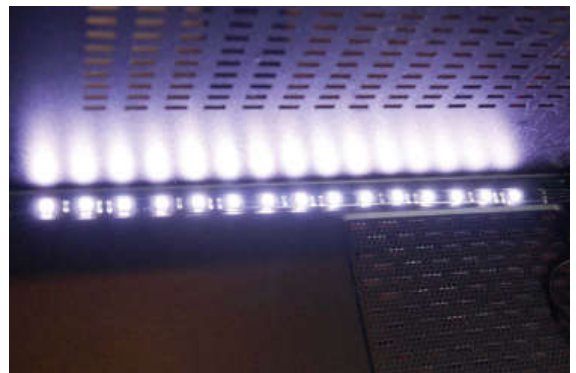
How to
Make a wooden HTPC case

Antony Leather shows you how to make an HTPC case fit for any TV cabinet

TOTAL PROJECT TIME / 24-48 HOURS

While Windows Media Center has been discontinued in Windows 10, a lounge PC is still useful as a single device that can play any video or music format, access any media streaming service, use Plex and work as a storage server. You don't have to be stuck with a hideous, bulky PC chassis in your TV cabinet either; you can make a great-looking wooden HTPC case yourself, using little more than a drill, Dremel and files. Add a plush veneer finish and you'll have a PC that looks more appropriate in your lounge than most set-top boxes.

TOOLS YOU'LL NEED
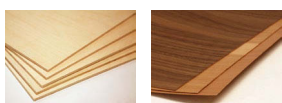
Birch plywood, balsa and wood veneer /
www.ebay.co.uk

Jigsaw or Dremel Moto Saw /
Most hardware stores

Gorilla wood glue and scalpel /
Most hardware stores

Drill and appropriate bits /
Most hardware stores

Clamps and sandpaper /
Most hardware stores

Power button and front USB ports /
Take from an old / cheap case or purchase separately

Motherboard standoff screw pack /
www.ebay.co.uk
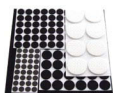
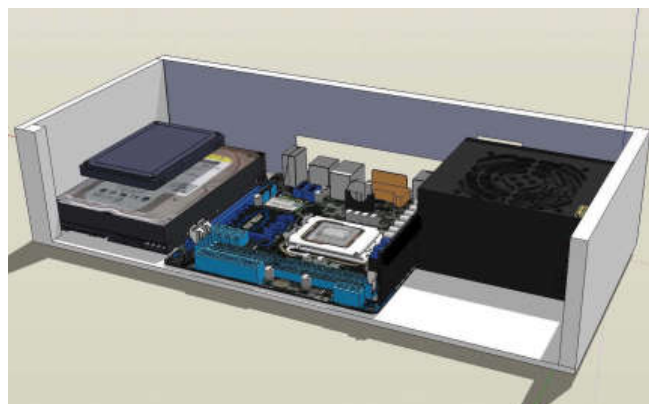**Self-adhesive rubber pads** /
www.amazon.co.uk

1 / DECIDE ON HARDWARE

To cut down on material costs, consider using an SFX PSU and mini-ITX motherboard, and not using a discrete graphics card if you don't need it. This will enable you to drastically cut down on the materials you use and build a smaller case.

2 / DESIGN YOUR CASE

Rendering programs such as Google's SketchUp are great tools for creating virtual models of your case and hardware. Pre-rendered objects are available at http://scc.jezmckean.com, enabling you to create a mock-up case in less than an hour – great for testing ideas.
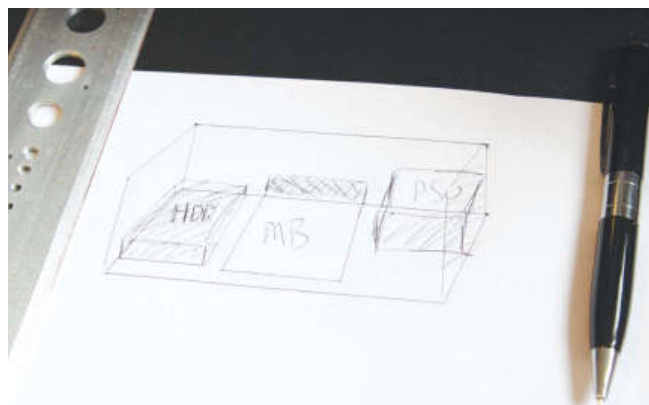
3 / DRAW YOUR IDEA

Of course, if you aren't familiar with rendering software, you can also design your case using simple paper and pen. You just need to work out where to place your hardware to create the best case. In the process, you may end up finding new ways to mount your hardware to cut down the size further.

4 / MAKE A SCALE MOCK-UP

Creating a basic mock-up of your case using cardboard can be really useful if you already own the hardware, as you can move the parts in real life to get an idea of which layout works best.

5 / USE ANOTHER CASE FOR SPARES

An old PC case can come in handy for all sorts of spare parts, including power and reset buttons, USB ports and even the motherboard tray, which you can cut out to save creating your own motherboard mounts.

6 / USE THIRD-PARTY MOTHERBOARD TRAY

Alternatively, if you don't have a spare case, you can purchase motherboard trays alone from **www.kustompcs.co.uk** for as little as £20 inc VAT. They come complete with expansion slots and motherboard standoffs, although our example will have an all-wood finish.

7 / ORDER THE WOOD

We've used a mixture of balsa sections and 3mm birch plywood. The balsa wood is easy to cut and great for internal fixtures and fittings, while the plywood is needed for the case panels and any sections or mounts that need to hold screws.

8 / CONSIDER USING VENEER

We'll be using veneer to cover our case, since it makes it look as though it's been crafted from a solid block of wood. It's rather expensive, delicate and time-consuming to use, but the end result is worth it. We used iron-on veneer that was very easy to apply.



9 / USE GLUE, NOT NAILS

There's no need to use nails – we used Gorilla wood glue instead and, when combined with clamps, this glue provides all the strength you need. A single bottle will be more than enough to build an entire PC case.

10 / SAND DOWN PANELS

The panels can initially have a slightly rough surface, which isn't ideal for applying the veneer later, so start by sanding them smooth, before hoovering up the dust and checking the edges for splinters.
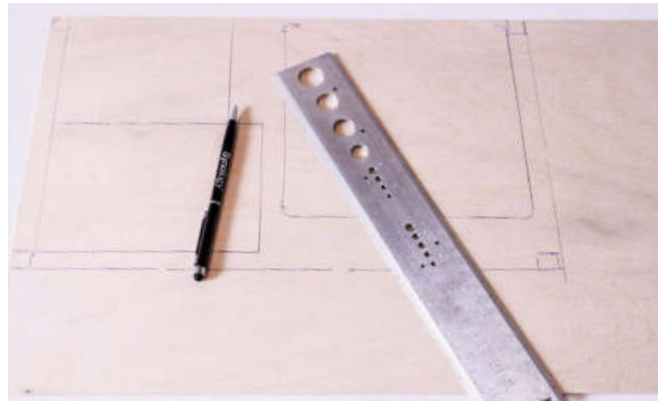
11 / MARK UP PANELS

Mark up the locations of your hardware so you know which panel goes where, and so you can make the rest of your measurements accurately. Once that job is done, you can work out the size of the panels you'll need.


12 / CUT TO SIZE

Once you know the dimensions of your case, cut the panels to size. A jigsaw with a fine wood-cutting blade, or a Dremel Moto Saw, will be perfect for this job, but you can also use a large hacksaw. Use a file to smooth the edges if your cuts aren't straight.


13 / CUT OUT CASE SUPPORTS

There are several ways to create the side sections. You can use a mitre saw to create angled edges that line up, but a simpler, cheaper way is to just use right-angled joins with corner supports. We'll be using four lengths of high density 12 x 12mm balsa that will also act as case lid supports.
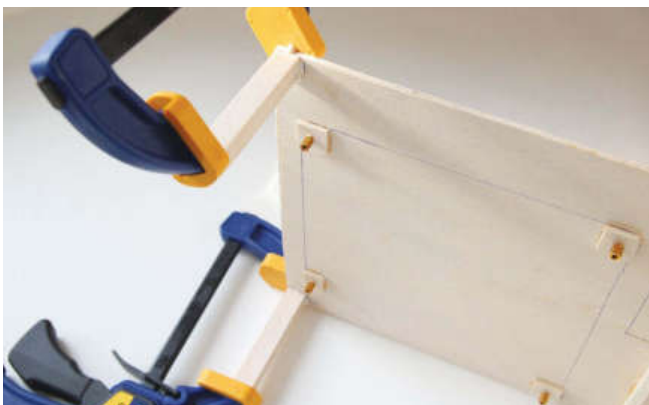
14 / GLUE AND CLAMP SUPPORTS

Make sure the support ends are straight and level, and then apply glue to each one before clamping them in place. You'll need to support the clamps to stop them pulling the supports at an angle, or potentially crushing one side after applying too much pressure.
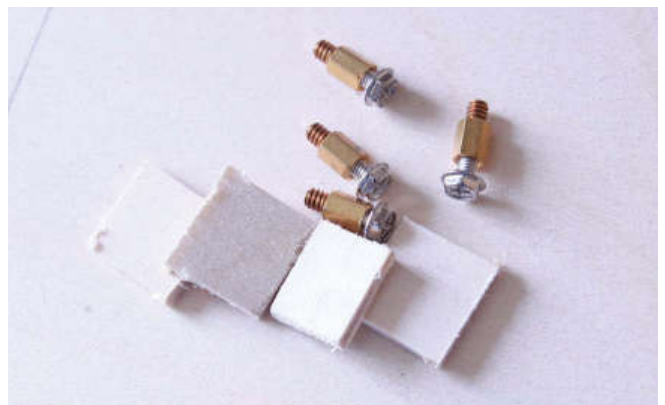
15 / CREATE MOTHERBOARD SUPPORTS

If you want to make your own motherboard mounts, start by cutting out 15 x 15mm squares of 3mm plywood. We also bought a pack of motherboard standoffs and screws. In the centre of the supports, drill holes slightly smaller than the screw threads, so the screws can bite.
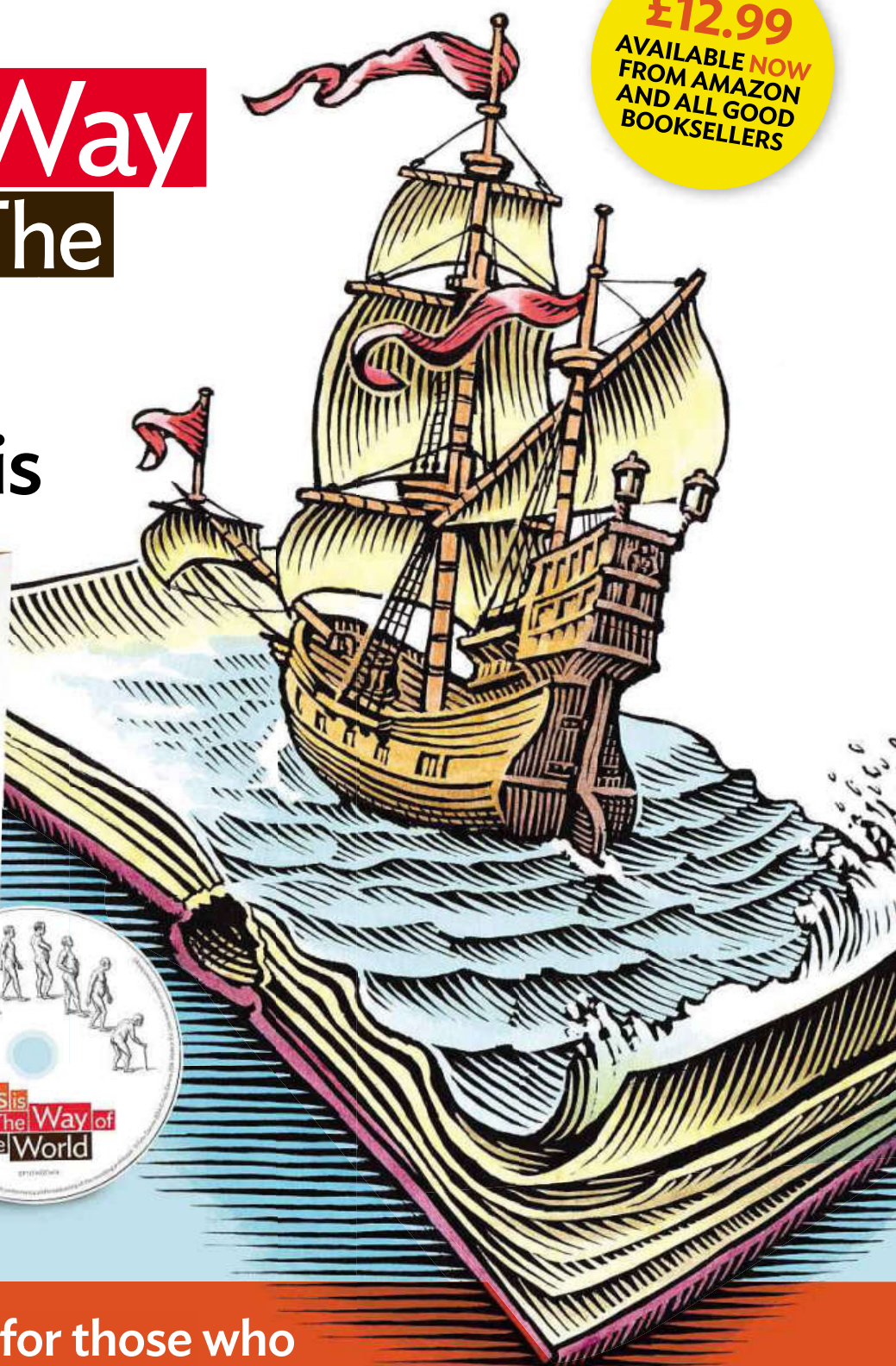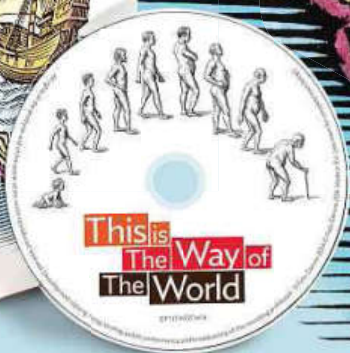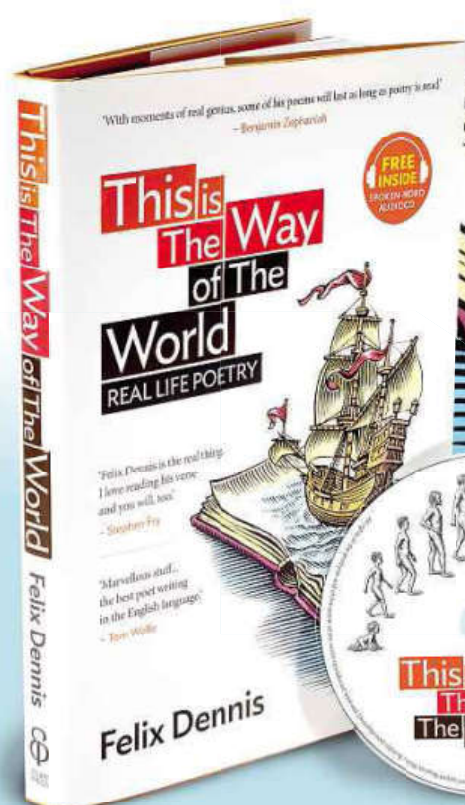
16 / INSERT STANDOFFS

You should then be able to insert the standoff screws into the mounts – one for each of your motherboard's mounting holes – four in our case. Make sure the screws are level at the same height.
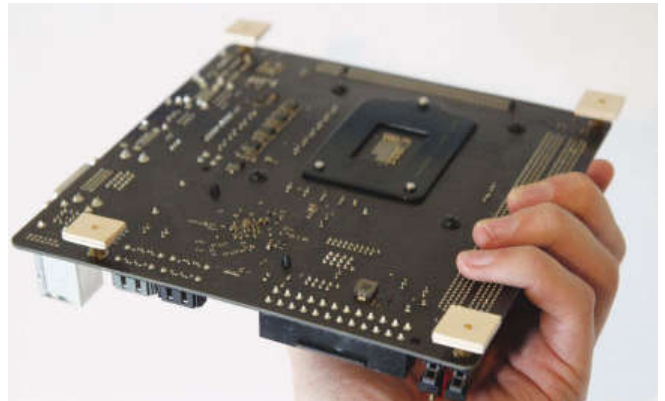
17 / FIX TO MOTHERBOARD

Fix the supports to the motherboard, apply glue and then mount the motherboard in place. This way, when you unscrew it, the mounts will be left behind, glued into the perfect position.

18 / MARK UP HARDWARE MOUNTS

Once the motherboard is in place, it's time to add supports for the hardware. We used 6 x 6mm balsa to outline the PSU mount to hold the power supply in place.

19 / CLAMP HARDWARE MOUNTS

Apply glue to the support stands and then use clamps to hold them in place while the glue dries. With Gorilla glue, you'll need to clamp them in place for at least 30 minutes.

20 / CREATE STORAGE MOUNT

The process of mounting an SSD and/or hard disk will vary depending on the size of your case. We're using both in a small area, so we've mounted them together before creating a plate attached to the hard disk's underside, which screws to a separate mount underneath that's glued to the case.

21 / TEST-FIT MAIN PANELS

With all your hardware installed, test-fit the top and bottom panels to make sure they fit. If you need more space, extend the main supports to raise the roof a little. We'll be mounting the lid using thin Velcro, but you can just as easily create runners using balsa wood.

22 / CUT AND IRON ON VENEER

Veneer is delicate and needs to be handled with care. Work out the size you need and then use a new scalpel blade to cut it – scissors or a jigsaw can make the surface crack. With iron-on veneer, use an iron on medium heat with no steam until the pre-applied glue melts, and then let it cool.

23 / CREATE OPTICAL DRIVE MOUNT

To mount our slim optical drive, we created a wood bracket using balsa to hold it to the front of the case, then a rear mount holding it in place. As the drive is so light, it only needs a minimum of mounting material, but you'll need more for a full-sized 5.25in drive.

24 / CUT OUT AIR VENTS

The cooling needed depends on your hardware. As we're using a 30W-TDP Core i3 and semi-passive PSU, we can get away with a few vents, but more powerful hardware will need more fans and vents. The PSU needs its own vent, which we cut out with a holesaw before sticking mesh to it.

25 / CUT OUT FRONT PANEL AND OPTICAL DRIVE HOLES

We transplanted a two-port USB 3 hub and a simple vandal-proof power switch from an old case. Cut out the power switch hole with a drill. You can use a smaller drill bit to start off the USB holes, and then enlarge them with a file. You can cut out the optical drive hole using a jigsaw and files.

26 / APPLY CASE FEET AND LID MOUNTS

Vents on the underside require case feet to provide floor clearance. We used 7mm rubber self-adhesive feet, but you could also use plywood to create taller feet. Meanwhile, the lid is so light that you can use thin Velcro to secure it along the supports.

27 / INSTALL HARDWARE

Tidy your cables to allow air to circulate, then power on the system, perform some typical HTPC tasks in the area you'll be placing the PC and watch the CPU temperature using Core Temp (www.alcpu.com). If it gets above 90°C, add more vents or consider installing an exhaust fan. **CPC**

Readers' Drives
Purpura

Fulfilling an ambition to mod a Dell XPS 720 case, Alain Simpels took his inspiration from a Persian carpet to build this floral-themed, water-cooled beauty

CPC: What originally inspired you to build Purpura?
Alain: I've always wanted to mod a Dell XPS 720. I fell in love with the design when the case was first released back in 2007. Seven years later, I was browsing the second-hand market for cases, and stumbled on an XPS 720 for sale. At that moment, I knew I'd found my base for a new case mod project. A few weeks later, I also bought a second XPS for spare parts.

CPC: Where did the name come from?
Alain: It's based on the purple coolant – the Latin translation of 'purple' is 'purpura'.

CPC: What specs did you choose, and why?
Alain: I built this PC for my own daily use, and the specs are from last-gen hardware. The motherboard was sponsored by Gigabyte, and at the time of the build, I got hold of two EVGA 780 OC graphics cards for some gaming power. The CPU is an i5-3570K, which is perfect for me and my daily use. Meanwhile, the water cooling came from EK.

The CPU block is full copper, and nickel-plated to match the nickel-plated copper pipes in the build. To cool the graphics cards, I used EK Plexi GPU blocks, so you can see the purple coolant running through them. I'm using an EK Coolstream 420 radiator with three 140mm Noctua fans – the latter are known for their high build quality and low noise. All the fans are also controlled using an Aqua Computer Aquaero 5; for me, this is one of the best fan controllers – it enables you to adjust a lot of settings to get an optimal cooling setup.

CPC: What mods have you built?
Alain: I've completed six projects so far. The design of the first one, Project Umbrella, was inspired by the fictional Umbrella Corporation in the Resident Evil games. The second project was a build for a friend called Black Obsession, which saw me using copper pipes in a water loop for the first time.

The next one was Project White, where I introduced the idea of using nickel-plated copper pipes in a water-cooling loop to the modding community. Entering this mod in several contests turned out to be a winning experience. Next up was CM Silencio 550 Limited Edition, which was specifically designed for a contest. It ended up having a mix of different features from my previous builds, including the copper pipe water loop, the use of Plexiglas, a top reservoir and a transparent case. Next was Grafit, with an open design and fully custom-made top reservoir. Finally, there was Eden, which was inspired by the G5 and had a wood effect.

CPC: What difficulties did you come across?
Alain: The first step was finding the right theme for this case. There are so many mods made from the XPS chassis, so I had to make my one stand out from the rest with a feature that pops out when you look at it, but with a little touch of elegance. After several days of looking for an appropriate pattern, I found a Persian carpet that features simple but beautiful designs. I loved it so much that I decided to integrate the design of the flowers into the base of the case.

The next issue was making sure both the panels would open in the same way, which is where the second case came in handy.

I stripped the second case's door-lock system, and after a few adjustments I could then install it on the first case's other side panel.

However, I first had to make sure that the space between the side, top and bottom panels was all the same, so I used a wooden brochette stick to even out the space everywhere.

CPC: What materials did you use?
Alain: I removed everything from the original case except the aluminium panels from the outside – I had to use 2mm metal to maintain enough strength in the case. I also redesigned the front with sufficient space to fit a 420mm radiator, and redesigned the back of the case, adding the Persian flower print. Also, the motherboard tray had to be redesigned by adding two loops in the middle of the tray, with extra room behind it to install a hard drive and SSD – I added the flower print to this area too. For the cable management, I used parts made from 8mm thick Plexiglas, which were designed by me and built by my friend Sander.

CPC: What tools and/or machinery did you use?

Alain: The metal panels were cut out with a CNC laser machine, providing the most precise and easiest way to give the panels a floral look. Meanwhile, the windows were designed by myself and then made by Justin from Parvum Systems. Likewise, the top reservoir in the case was designed by me, and then made by Nate from www.e22.biz. Working with people who have CNC equipment makes life a lot easier, as these machines can cut and bend material with better precision than I can.

CPC: What media interest has Purpura attracted?

Alain: When the build was finished it was shared all over Facebook. I received a lot of compliments on the end result, and many people loved the details that were added in the case. I shared the end result with the sponsors, who also shared it on their Facebook pages.

CPC: How long did it take to build?

Alain: Around 18 months. In this time, I had a ten-month break in which I built another project, Eden, for Modding Trophy 2014. A few months after this event, I continued my work on the Dell XPS.

CPC: What did you learn from the build process?

Alain: Finding a good and original theme for every build is quite challenging. I always look for a suitable theme that works with the case, and try to make it unique or special. It takes me a lot of time to work out a theme and get inspired.

I didn't use any products or techniques that were new to me for this mod though – it was all familiar to me.

CPC: Are you happy with the end result, and is there anything you'd do differently if you built it again?

Alain: Yes, I'm very pleased with the overall result! If I had a chance to redo it I would make a few adjustments to the case though. Firstly, I would swap the Louvre-style vents at the front of the case for a chrome grille. Secondly, I would change the PSU position by turning it 90 degrees, similar to the PSU mount in the SilverStone TJ07. The new PSU angle would give me extra room to mount hard drives and SSDS, which are currently installed on the back of the motherboard tray. **CPC**

SYSTEM SPECS

CPU Intel Core i5-3570K

Graphics card 2 x EVGA GeForce GTX 780 OC SLI

Memory 16GB Corsair Platinum 1600MHz

Case Dell XPS 720

Motherboard Gigabyte GA-Z77X-UP4TH

Storage 256GB OCZ SSD, 2TB Western Digital Caviar Green hard drive

PSU Cooler Master V850

Cooling EK-Supreme HF Full Nickel CPU block, EK-FC TITAN SE Nickel Plexi GPU block, Koolance Pump PMP-400 with EK-DDC X-TOP V2 Plexi pump top and EK-DDC Heatsink Housing Nickel pump house, Phobya Balancer 150 Silver Nickel reservoir, EK-CoolStream RAD XTC 420 radiator, Aqua Computer Aquaero 5 fan controller, custom-made top reservoir by **www.e22.biz**, custom-made windows by **www.parvumsystems.com**

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Corsair graphite Series 230T case and RM 550w Modular power supply

TOTAL VALUE £150 inc VAT / **MANUFACTURER** www.corsair.com

Corsair believes that a great PC starts with a great case. The Corsair Graphite Series 230T is a compact expression of this core philosophy. With stylish looks and a choice of three different colours, it packs in a remarkable number of features to provide builders with tonnes of room for expansion and amazing cooling potential. Like all Corsair cases, it's built using the finest materials and finished to the highest standards, so it will withstand several years of upgrades. Plus, to make sure it stand outs from the crowd, the 230T features Corsair's new Air Series LED high-airflow fans, providing distinctive lighting with low-noise, high-airflow cooling.

Just as a quality case is essential to building a quality PC, a high-performance, a high-quality power supply is also a vital ingredient. The all new RM series has been built from the ground-up to deliver unmatched reliability alongside 80Plus Gold efficiency, and all with the absolute minimum of noise. It uses specially optimised quality parts to reduce sound at the component level, and it's completely silent below 40 per cent load, thanks to its Zero RPM fan mode. It's also fully modular, allowing for the maximum amount of flexibility during installation. With a Corsair Graphite 230T case and an RM 550W Modular power supply at the heart of your build, you'll have the foundations for a truly awesome gaming machine.

Mayhems coolant and dyes

VALUE £50 inc VAT / **MANUFACTURER** www.mayhems.co.uk

Cooling performance is only one part of the equation when it comes to kitting out your rig with custom water-cooling gear. The other major bonus is that all those tubes and gleaming fittings just make your PC look damn sexy, and they look even better when they're pumped full of fancy coloured coolant. As such, we're particularly pleased to have the folks at Mayhems now on board with Readers' Drives; they're currently offering two 1-litre bottles of Mayhems' Pastel Ice White coolant, along with a selection of five dyes, so you can choose the colour that best complements your PC. Check out the blue coolant in our own mini PC mod on the cover of Issue 109 for an example of what's possible with some Mayhems coloured coolant.

Phobya Modding Kit

VALUE £50 inc VAT **MANUFACTURER** www.phobya.com, www.aqua-tuning.co.uk

The Phobya modding kit is designed with the modder in mind, offering great value for money and quality products. The kit includes Nano-G 12 Silent Waterproof 1,500rpm multi-option fans, which use an innovative fan-blade design. As standard, the fans include braided black cables to keep your case looking as neat as possible. The fans are also supplied with a special cable that lets you run the fan at 5V rather than 12V, reducing the noise emitted in order to help you to build a silent system.

The kit also includes the 60cm Phobya 3-pin Molex to 4x 3-pin Molex Y-cable. This pre-braided extension cable gives you extra routing options in your case, and it also enables you to run up to four fans from one compatible motherboard header. Meanwhile, the Phobya SATA 3 cables included in the kit offer the same great quality braiding as the rest of the Phobya range, while also securing your connection with latched connectors. As well as this, the kit includes the Phobya SlimGuide Controller, which gives you the option to vary the speed of other fans in your case, while the Phobya TwinLEDs let you shine a light on your mods.

CUSTOM PC

REALBENCH 2015

in association with ASUS

Give your PC a workout with our new benchmark suite, and see how your rig compares to other readers' machines

BENCHMARK YOUR PC

Download the benchmarks from www.asus.com/campaign/Realbench and, before you run them, disable any power-saving technologies in your BIOS that change your CPU clock speed, or the leaderboard won't record your overclock frequency properly. To post a score on the leaderboard, go to Save Upload File in the RealBench 2015 app's Results menu, and save your results in an RBR file. You need to select Offline Uploads on the leaderboard site, sign up for an Asus account and upload your file.

Gimp

We use Gimp to open and edit large images. Unlike our previous Gimp test, this one uses more than one CPU core, although it's still more sensitive to clock speed increases than to more CPU cores.

Handbrake H.264 video encoding

Our heavily multi-threaded Handbrake video encoding takes full advantage of many CPU cores, pushing them to 100 per cent load.

LuxMark OpenCL

This GPU compute test is the only synthetic part of our suite, although the renderer is based on the real LuxRender physically based rendering software. As 3D rendering is a specific workload that not everyone will use, and because OpenCL support isn't standard in most software, this section is given just a quarter of the weighting of the other tests in the final score.

Heavy multi-tasking

Our new multi-tasking test plays a full-screen 1080p video, while running a Handbrake H.264 video encode.

Scores

RealBench 2015 breaks down the scores for each test, then gives you a total system score and a percentage reference score.

On an Intel system, the 100 per cent reference score comes from a stock-speed Core i7-4790K, with 16GB of Corsair 2,400MHz DDR3 memory, a 240GB OCZ 150 SSD, an Asus Maximus Gene VII motherboard and an Nvidia GeForce GTX 780 3GB graphics card.

On an AMD system, the 100 per cent reference score comes from a stock-speed A10-7850K APU, with 8GB of Corsair 2,133MHz DDR3 memory, a 256GB Plextor M5 Pro SSD and an Asus A88X-Pro motherboard, using the APU's integrated graphics. **CPC**

SHOUT OUTS!

Again, there's been no change at the top, with ian.parry3 (8Pack at www.overclockers.co.uk) still ruling the top spot, but we've had a few changes in the top 20. Hats off to new entries grozzie and bennunn this month, and in particular, stuart, who is now at number three, using an 8-core Intel Core i7-5960X overclocked to 4.49GHz.

CHROME WARNING

At the moment, Google's Chrome browser flags up the RealBench 2015 download as potentially harmful, and we're aware of this issue. The file is perfectly safe, however – please ignore this warning.

CUSTOM PC REALBENCH 2015 LEADERBOARD

| RANK	SYSTEM SCORE	REFERENCE	USERNAME	MOTHERBOARD	CPU	CPU CLOCK	MEMORY	PRIMARY GPU
1	233,375	203.9%	ian.parry3	Asus Rampage V Extreme	Intel Core i7-5960X	4.6GHz	32GB G.Skill 3200MHz	Nvidia GeForce GTX Titan X
2	219,415	191.71%	Luke@DinoPC	Asus Rampage V Extreme	Intel Core i7-5960X	4.6GHz	16GB Corsair 3276MHz	Nvidia GeForce GTX Titan X
3	202,986	177.35%	stuart	Asus Rampage V Extreme	Intel Core i7-5960X	4.49GHz	16GB Corsair 2133MHz	Nvidia GeForce GTX 780 Ti
4	201,446	176%	CustomPC	Asus Rampage V Extreme	Intel Core i7-5960X	4.3GHz	16GB Corsair 2666MHz	Nvidia GeForce GTX Titan X
5	197,964	173%	Carbonleg	Asus X99-E WS	Intel Core i7-5960X	Not reported	32GB Corsair 2400MHz	AMD Radeon R9 200 Series
6	189,230	165.3%	shadowsrayne	Asus Rampage V Extreme	Intel Core i7-5960X	4.2GHz	32GB Corsair 2133MHz	Nvidia GeForce GTX 980
7	172,828	151%	mdottwo	Asus Rampage V Extreme	Intel Core i7-5820K	4.4GHz	16GB G.Skill 2766MHz	AMD Radeon R9 200 Series
8	167,332	146%	grozzie	ASRock X99M Killer	Intel Core i7-5930K	4.48GHz	32GB Kingston 3071MHz	AMD Radeon R9 200 Series
9	167,002	146%	maliepaard.chris	MSI X99S SLI Plus	Intel Core i7-5820K	4.49GHz	16GB Corsair 3000MHz	Nvidia GeForce GTX 980 Ti
10	166,078	145.1%	Chris_Waddle	Asus Rampage IV Black Edition	Intel Core i7-4930K	4.72GHz	16GB Corsair 2464MHz	Nvidia GeForce GTX Titan X
11	165,512	144.6%	Penfold	Asus X99-Deluxe	Intel Core i7-5820K	4.5GHz	32GB Corsair 2333MHz	AMD Radeon R9 200 Series
12	163,650	143%	shaunhanson	MSI X99S SLI Plus	Intel Core i7-5820K	Not reported	16GB Corsair 2133MHz	Nvidia GeForce GTX 980
13	163,400	142.7%	andy	MSI X99S Gaming 7	Intel Core i7-5820K	4.4GHz	16GB Corsair 2666MHz	Nvidia GeForce GTX 980
14	163,065	142.5%	viperz	Asus X99-Deluxe	Intel Core i7-5820K	4.48GHz	16GB Corsair 2400MHz	Nvidia GeForce GTX 970
15	160,855	140.5%	imre_grozner	ASRock X99M Killer	Intel Core i7-5930K	4.19GHz	32GB Kingston 2666MHz	AMD Radeon R9 200 Series
16	157,611	137.7%	andrew_mcse	Asus Rampage IV Black Edition	Intel Core i7-4930K	4.49GHz	16GB Corsair 2400MHz	AMD Radeon R9 200 Series
17	155,685	136%	MAQ	Asus Rampage V Extreme	Intel Core i7-5930K	Not reported	32GB Corsair 2133MHz	Nvidia GeForce GTX 970
18	154,116	135%	bennunn	Asus X99-Deluxe	Intel Core i7-5820K	4.08GHz	32GB Corsair 2447MHz	Nvidia GeForce GTX 980 Ti
19	153,557	134.2%	hutch	Asus Rampage IV Extreme	Intel Core i7-4930K	4.59GHz	32GB Kingston 2400MHz	AMD Radeon R9 200 Series
20	148,641	129.9%	claire.york83	Asus X99-S	Intel Core i7-5820K	4GHz	16GB G.Skill 2666MHz	AMD Radeon HD 7900 Series

Folding@Home

Join our folding team and help medical research

MILESTONES THIS MONTH

USERNAME	POINTS MILESTONE
Capt-Camm-Nett	20000
ricola86	20000
ruiyyanko	20000
tallandgentle33uk	50000
Jimbobjr88	70000
pig_farmer_uk	70000
ZeroExistancE	70000
upthesaddlers+mrslippery	90000
Ayeska	100000
BenScoobert	100000
callumtho	100000
mort6dav3	100000
Parmesan	100000
Philhasnoidea whathe\\'sdoing	200000
TimmyH	300000

USERNAME	POINTS MILESTONE
Jaffo	400000
MrDevious	400000
scoobyzilla	400000
TheTomBoy	400000
Just_G	500000
ManxBob	500000
RougeNikov	500000
Glyn_Mason	600000
jamiesp17	700000
QuasarGreg	700000
tastyradiskull	700000
GJBriggs	800000
Quozzbat	800000
daza17	900000
siddallj	900000
LboroSlider	1000000
MikePreston	1000000

USERNAME	POINTS MILESTONE
wew	1000000
Zaratoustra	1000000
Ganey	2000000
Trevrev	3000000
SMauri	4000000
andboo1	5000000
Werewolf_Legs	5000000
Scammelio	6000000
GreenDemon360	7000000
Ken_Swain	7000000
PRJKITCH	7000000
Skidder	7000000
Brentwood-Computers.com	8000000
matgsi	8000000
Mem	9000000
Trunkey	9000000

USERNAME	POINTS MILESTONE
daxchaos	10000000
RabidMongoose	10000000
rvalkass	10000000
slowpurple	10000000
SP1	10000000
Andy_J	30000000
Portchylad	30000000
ZardozSpeaks	30000000
Maglor	40000000
pompeyrodney	40000000
Cmaxx	50000000
PS3/LanDi	60000000
Dickie	70000000
Wilding2004	80000000
Roveel	90000000
johnim	400000000
PC_Rich	400000000

WHAT IS FOLDING?

Folding@home uses the spare processing cycles from your PC's CPU and graphics cards for medical research. You can download the client from **http://folding.stanford.edu** and our team's ID is 35947. Once you pass a significant milestone, you'll get your name in the mag. You can also discuss folding with us and other readers on the **www.bit-tech.net** forums.
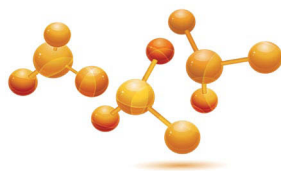
TOP 20 OVERALL

RANK	USERNAME	POINTS	WORK UNITS
1	Nelio	2,386,026,406	129,057
2	DocJonz	1,267,077,270	177,292
3	coolamasta	756,194,175	169,832
4	Scorpuk	625,995,556	16,355
5	StreetSam	566,337,446	90,124
6	piers_newbold	565,530,157	42,871
7	Dave_Goodchild	464,762,819	119,324
8	PC_Rich	407,757,953	76,398
9	johnim	406,058,212	80,907
10	HHComputers	367,225,936	18,831
11	Slavcho	325,782,269	33,769
12	Lordsoth	288,735,106	94,015
13	The_M2B	279,240,698	57,494
14	phoenicis	250,044,587	95,660
15	Wallace	212,477,027	6,204
16	zz9pzza	211,014,628	15,794
17	TheFlipside	192,058,089	21,552
18	Laguna2012	185,636,538	18,941
19	Desertbaker	183,594,718	16,306
20	Ben_Lamb	166,053,146	2,891

TOP 20 PRODUCERS

RANK	USERNAME	DAILY POINTS AVERAGE	OVERALL SCORE
1	DocJonz	2,465,615	1,267,077,270
2	piers_newbold	1,593,154	565,530,157
3	HHComputers	1,301,954	367,225,936
4	Dickie	1,014,020	71,001,051
5	PC_Rich	913,261	407,757,953
6	Laguna2012	838,908	185,636,538
7	apeman556	619,287	137,817,184
8	Scorpuk	571,332	625,995,556
9	Desertbaker	558,213	183,594,718
10	Lordsoth	552,776	288,735,106
11	The_M2B	550,787	279,240,698
12	Nelio	495,080	2,386,026,406
13	johnim	489,582	406,058,212
14	daxchaos	376,027	10,172,139
15	StreetSam	353,998	566,337,446
16	Roveel	321,751	99,713,946
17	Maglor	315,057	44,346,960
18	slowpurple	286,967	13,289,122
19	Andy_J	285,409	30,234,330
20	coolamasta	278,309	756,194,175

JAMES GORBOLD / HARDWARE ACCELERATED

VALVE'S STEAM OS IS ALIVE

Contrary to popular opinion, Steam OS isn't dead.
In fact, it's looking great, argues James Gorbold

S team OS and the first batch of Steam Machines were first unveiled at CES in January 2014. While I didn't make it to the show, I was lucky enough to be involved in the design of the UK's first Steam Machine, the Scan 3XS NC10. Since then, however, Steam OS has lived under a cloud, with the release date being pushed back again and again.

Although the wait has been painful, looking back at where we were then and where we are now, Valve undoubtedly made the right decision to hold back the launch. For instance, the first few beta releases of Steam OS were little more than a crudely skinned Debian distribution, complete with its own foibles, such as a horrendous installation process that had a nasty habit of wiping drives.

Driver support was also poor in the early days, with only a handful of GPUs supported. And when, or if, you finally managed to get a working installation, Steam OS turned out to just be Steam Big Picture mode running on Linux, with barely more than 100 games available.

Roll the clock forwards to September 2015 and Steam OS is barely recognisable from its clunky early beta. It now installs smoothly, and it supports the vast majority of GPUs, although laptops are still problematic. Plus, although it's still based on Debian, its Linux roots are better hidden, making it much harder to get to the desktop or command prompt and screw anything up – an important consideration for a consumer OS, especially one aimed at living-room PCs.

The interface has also evolved, with a more intuitive menu structure that's far easier to navigate whatever controller you use. For instance, you can now quickly and easily flick between a running game, the Steam Store and browsing the Web.

The Steam Controller has been given several massive overhauls in this time too. Valve has finally settled on a controller that combines the best of traditional gamepad design with dual trackpads that are surprisingly good for playing first-person shooters, which of course remain the most popular game genre on the PC.

Even if I'd still rather use a keyboard and mouse myself, the Steam Controller makes playing PC games from the sofa in your living room a real possibility, especially as the production version has ditched the long wires in favour of a wireless Bluetooth connection.

> The Steam Controller makes playing PC games from the sofa in your living room a real possibility

Meanwhile, the library of games, the Achilles heel of any new gaming system, has mushroomed in recent months. There's still no killer game from Valve, but the firm is definitely trying to get as many games as possible released on Steam OS. As I write this column, there are now 1,447 games available on Steam OS, with six of the top ten most popular games being available to play on the new OS.

I don't see Steam OS posing a big threat to Windows, but instead acting more like a complementary product, with gamers keeping their big Windows PCs in their spare room while a Steam Machine sits in the living room. However, the huge increase in quality and usability of Steam OS, and its controller over the past two years could make it a serious threat to the aging PS4 and Xbox One when it's finally released later this year. **CPC**

James Gorbold has been building, tweaking and overclocking PCs ever since the 1980s. He now helps Scan Computers to develop new systems.